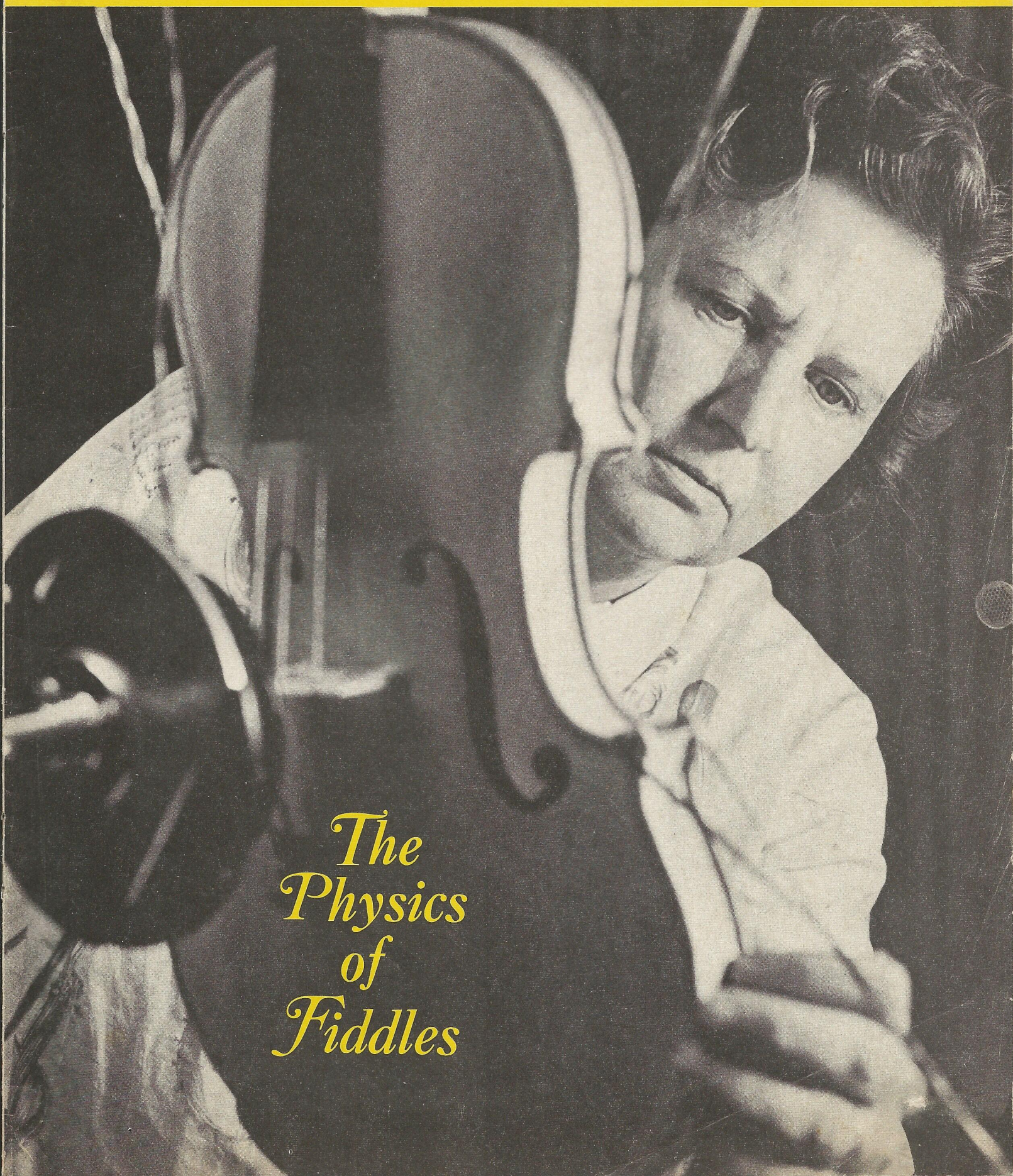
MARCH 7, 1968 • VOL. 23 • NO. 5 • A SCHOLASTIC MAGAZINE

SENIOR SCIENCE

For Classes in Biology, Chemistry, Physics, Earth and Space Science



The Physics of Fiddles

THE BEST CATCH IN BASEBALL IS THE WILSON A2000.

And that's the best catch phrase a ball player can keep in mind. Especially coming from Ron Santo*, a man to whom catching is a way of life.

Ron's been playing the A2000 ever since he joined the major leagues.

And it's paid off. In 1967 he was named outstanding fielding third-baseman of the year, an honor he's grabbed four straight years.

Catching the ball and holding on to it: a way of life for a fielder that demands some mighty ingenious engineering features in a glove.

The patented web, for example, is adjustable and vertical dual-hinged. This glove really swallows the ball whole!

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Streamlined back fingers are shaped in natural playing position—they're poised to nab the pill before you are! And the new adjustable wrist strap assures firm control.

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Catch?

ASK RON SANTO.

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ANSWERS TO BRAIN TEASERS
(see page 16)

Last Horse Wins

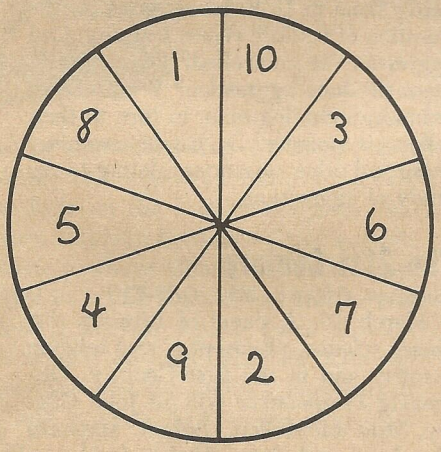
The two men should change horses and race. Each will then be riding the other man's horse and, by winning the race, can prove that the other man's horse is faster.

Slow Boil

Start the five and six minute glasses together. At the end of five minutes, start boiling the egg. One minute later, when the six minute glass is finished, start the three minute glass. When the three minute glass is finished you will have boiled the egg for four minutes. The whole process takes nine minutes, but you did not begin boiling the egg until five minutes had elapsed.

Opposite Numbers

The requirements of the problem can be met by positioning the numbers as shown below.



Dollar Drain

Although at first glance it appears logical, there is no reason to add $2 to the $27 the men actually paid, and expect to arrive at the amount they paid originally. The men first paid $30 and received $3 back, making their payment $27. The $2 taken by the bellhop represents part of this $27. The hotel collected $25 of it, and the bellhop the other $2. There is no reason to add that same $2 in again to get a final accounting. Rather, the $3 returned must be included, which then accounts for the full amount.

$25 (hotel) + $2 (bellhop) + $3 (refund) = $30.

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The girl with the pHisoHex® skin

This Girl Loves To Show Her Face.
Skiing is her sport. Sunlight is her friend.
She's the girl with the pHisoHex skin.

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pHisoHex is a liquid antibacterial skin cleanser whose cleansing action removes dirt, make-up, and pore-clogging oils that often cause pimples, whiteheads and blackheads. And this is vitally important: pHisoHex contains an antibacterial called hexachlorophene, which combats germs and deposits its invisible germ-fighting protection on your skin *between* washings. That's why we suggest that you don't use soaps or other cleansers when you're using pHisoHex: they might remove this protection.

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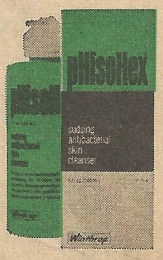


Would you like to know more about skin care and other personal pointers? Send for a free booklet today: for girls, "Teenaged? Have acne? Skin care and personality pointers"; for boys, "Good grooming guide for busy guys." We believe you'll find each very helpful.

Winthrop Winthrop Laboratories, 90 Park Avenue, New York, N. Y. 10016

Teens ask Toni ...

Q. *I'm getting my hair trimmed to the new medium length. How should I wear it? (I have bangs.) D. L., Akron, O.*

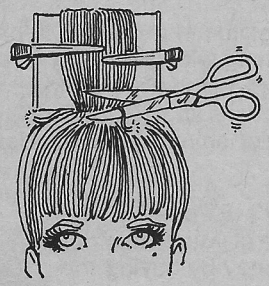
A. Choose a 'do that's equally smashing for school, or evening datery. For example: the soft, curvy coif shown here. Sheared to just below the ears. With a smoothly rounded crown, and ends sweeping forward into a gentle upcurve. And, to *up-play* your new 'do-appeal, start with what turns it on —to stay: The UNcurly Toni! This quiet-mannered permanent gives your hairstyle body, shape, curve—the kind that holds for *keeps*. Result? A zazzy 'do like this can go all day (and go-go all night) without losing its shape or chic! *Try* UNcurly Toni.

Q. *Long straight styles are my bag, but nothing sets my hair as straight as I'd like it! Any help? T. J., Baltimore, Md.*

A. Plenty! The "bag" for you is Dippity-do—the clean n' sparkly setting gel that makes setting neater; faster; lets you get even the sleekest look—plus the extra hold it needs. (*Loaded* with body!) You simply smooth on Dippity-do, and your hair *grabs* the rollers! (No slips or drips.) Helps keep straight styles swinging straighter. Fab smoother-outer for bangs, too; and other slick effects you fancy. Now, bend an ear to *this:* You can get a 2 oz. trial size Dippity-do FREE! Regular, or extra holding. Send only 15¢ (for postage and handling) with your name, address and zip code, to DIPPITY-DO, Box 3001, Maple Plain, Minn., 55359. Then, try this new "CAN DO" for a super-straight look with *superific* hold!

1. *Recipe:* Dippity-do, and a 1 lb. coffee can (to use as a giant roller!) Make a ponytail on top.

2. Dippity-do it . . . comb through it. Wrap hair around coffee can.



3. Clip in place. Then snip off rubber band from ponytail, and you're set . . .

4. . . . to swing! With a *super* set. Because Dippity-do's super-bodiful hold sets it straight . . . keeps it straight! (Great combo: a super roller—and Dippity-do!)

Any questions about hair care? Write Carol Douglas, The Toni Company, Box 3600, Chicago, Illinois 60654. Include your complete name and address.

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Science on TV

Animal Secrets

(Sundays, 5:00 P.M. EST, NBC-TV)

March 10: What do investigations with animals tell us about how enriched or deprived environments affect the potential of the brain? The ability to learn? Is there a direct relationship between nutrition and intelligence? Between stress in early life and the ability to adapt later on? How does one critical time affect another? Dr. Loren Eiseley reports on studies examining the importance of brief critical periods in permanently directing the pattern of future development.

March 17: The final new show of the current season (programs will be rebroadcast through April) explores the question of *Aggression – or Love?* The filmed report includes a look at research being done in U. S. laboratories on the question of instinct versus learning. Can aggression be controlled? Does punishment produce aggression? What causes animals, including man, to turn to their fellows in violence? Dr. Eiseley examines these and other questions relating to the study of aggression.

The 21st Century

(Sundays, 6:00 P.M. EST, CBS-TV)

March 10: A panel of futurists discusses science, philosophy, and religion – today and in the 21st Century. Discussing *Perspectives* will be John Cogley, Roy McMullen, Robert Maynard Hutchins, and Peter Ritchie Calder.

March 17: A special report on *Techniques in Psychiatry* focuses on the work of Dr. Thomas Stampfl, a psychiatrist at the University of Wisconsin, and his treatment of a 21-year-old girl.

Wild Kingdom

(Sundays, 7:00 P.M. EST, NBC-TV)

March 10: This week: an adventure with the Masai tribe in *Beneath Kilimanjaro* as a United Nations mission conducts a study to determine whether Masai cattle and the wildlife at the base of Mount Kilimanjaro can co-exist on the same grazing land. Viewers will see the darting and banding of a bull elephant and a bloodletting ritual of the Masai people.

March 17: An ancient deserted castle in Rajasthan, India – in the province of Sawai Madhopur – has been taken over by a leopard family. *Leopards of Sawai Madhopur* is the filmed story of these leopards and the other animals that live nearby.

– PEGGY HUDSON

SENIOR SCIENCE

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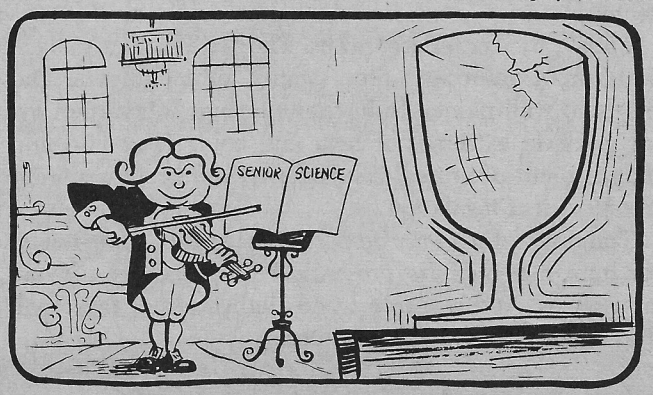
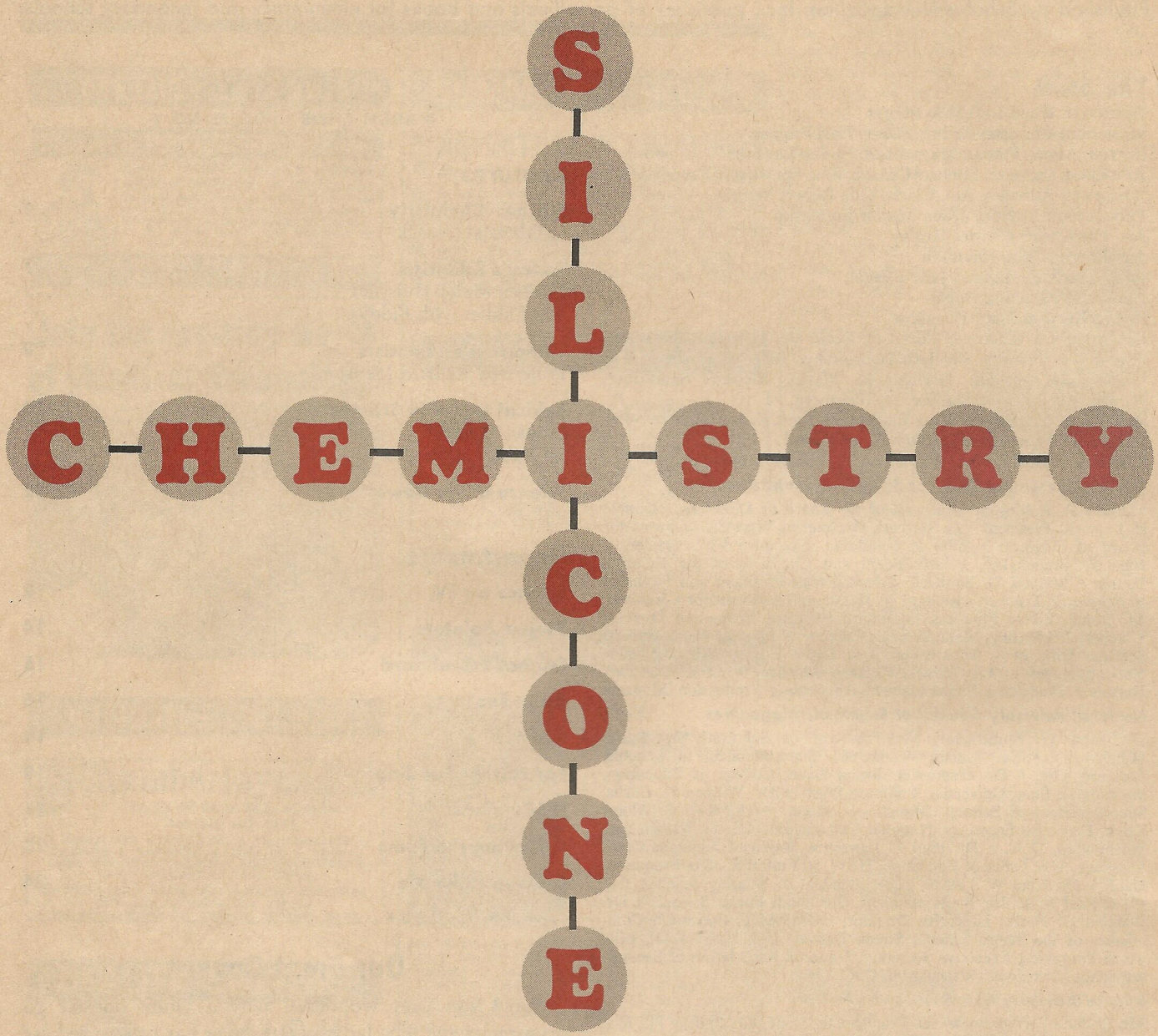
Cover photo: Bruce Frisch

Our Front Cover

Have you ever wondered why a violin doesn't go *oom-pah-pah*? The lady on our cover has progressed far beyond this point. In fact, she has learned why a $50,000 fiddle sounds better than a $5 one. What's more, she's done something about it. Would you believe superviolin? Read all about the physics of a fantastic family of fiddles in the article beginning on page 7.

Drawing by Ted Blake





EXACTLY 25 years ago this month the *silicone* industry was born. But no one cheered the event. Few people heard of silicones – they were wartime secrets.

Today, they're all around us. They stiffen shirt collars, waterproof raincoats, repel stains, protect floors, and brighten wall paints. Industrial silicones lubricate moving parts in extremes of heat and cold. They also seal moisture out of critical instruments, and provide unfailing electrical insulation.

Tomorrow, they may be *part* of us. Many "spare parts" for human beings are presently being made of silicone substances. And research trends indicate that these will dramatically increase in number.

What are these miraculous silicones?

Silicones are various synthetic (man-made) compounds of silicon, oxygen, and organic groups (molecules of carbon and other elements) linked in chains, rings, and networks. There's nothing like them in nature. Man, by linking carbon and silicon, has created a family of remarkable substances.

Carbon combines naturally with most elements (more than two million compounds of carbon have been isolated), but not with silicon. Yet these two elements make up a large portion of our world. All living things – and remains of once-living things – contain carbon. And silicon is the main component of rocks and sand; it's the second most plentiful element in the Earth's crust.

Carbon (atomic number 6) has an outer shell of four electrons. Thus, a carbon atom can form *covalent bonds* with (share electrons with) four neighboring atoms. This accounts in part for carbon's ability to combine with other elements in two million different ways. The study of carbon compounds is so important that chemistry is treated in two major branches – *organic* (with carbon) and *inorganic* (without carbon).

Silicon (atomic number 14) also has an outer shell of four electrons. In fact, silicon is the element closest to carbon in chemical properties. Therefore, scientists long believed that an extensive group of compounds based on silicon – similar to the vast number of organic compounds – could be developed. But the idea didn't work out. True, silicon will combine with many elements to form hosts of compounds. But most of these compounds will turn to sand (*silica*, SiO_2) in the presence of water.

"Unnatural" Compounds

Although chemically similar, carbon and silicon are startlingly different in some ways. A carbon atom is relatively small: Two shells of electrons orbit its nucleus. The outermost shell contains four electrons – a total of eight would complete it.

With three shells, a silicon atom is considerably larger. Its outermost shell also has four electrons. But 18 electrons are needed to fill that shell. And because the outer electrons are farther from the nucleus, silicon is more reactive (more inclined to lose electrons) than carbon. For this reason, silicon is never found alone in nature. It's usually combined with oxygen.

Carbon and silicon both bond to other atoms by sharing their four outer electrons with them. The other atoms group symmetrically around the carbon and silicon atoms. In carbon compounds, these other atoms are stiffly bound in place. But in silicon compounds – because there's more room in the outer silicon shell – the linked atoms can move back and forth in place. The bonding is flexible. This flexibility is very important when silicon, oxygen, and carbon groups are linked to form silicones.

Just over a hundred years ago, James Crafts, an American scientist in Paris, made an "unnatural" compound by linking silicon and carbon. And he discovered that such compounds don't easily revert to sand; the

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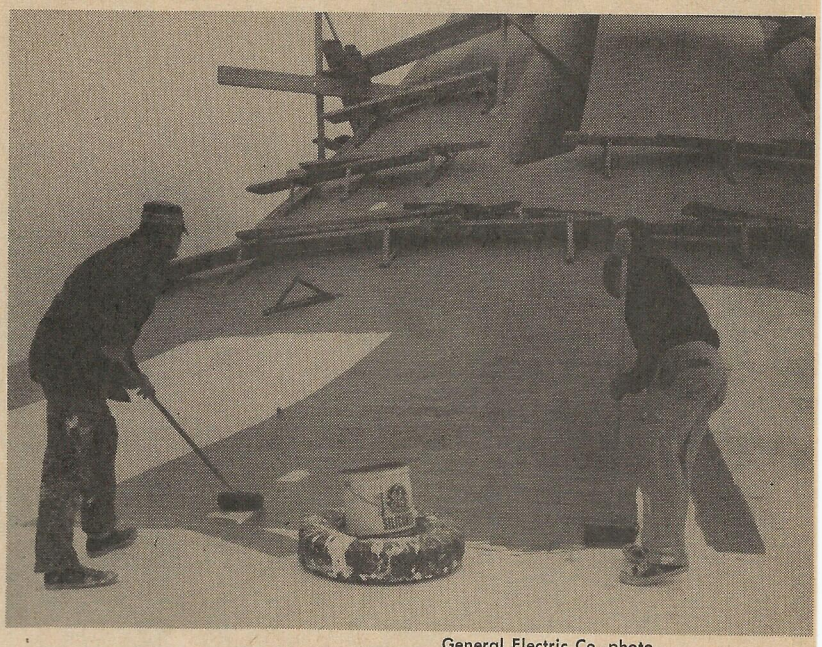
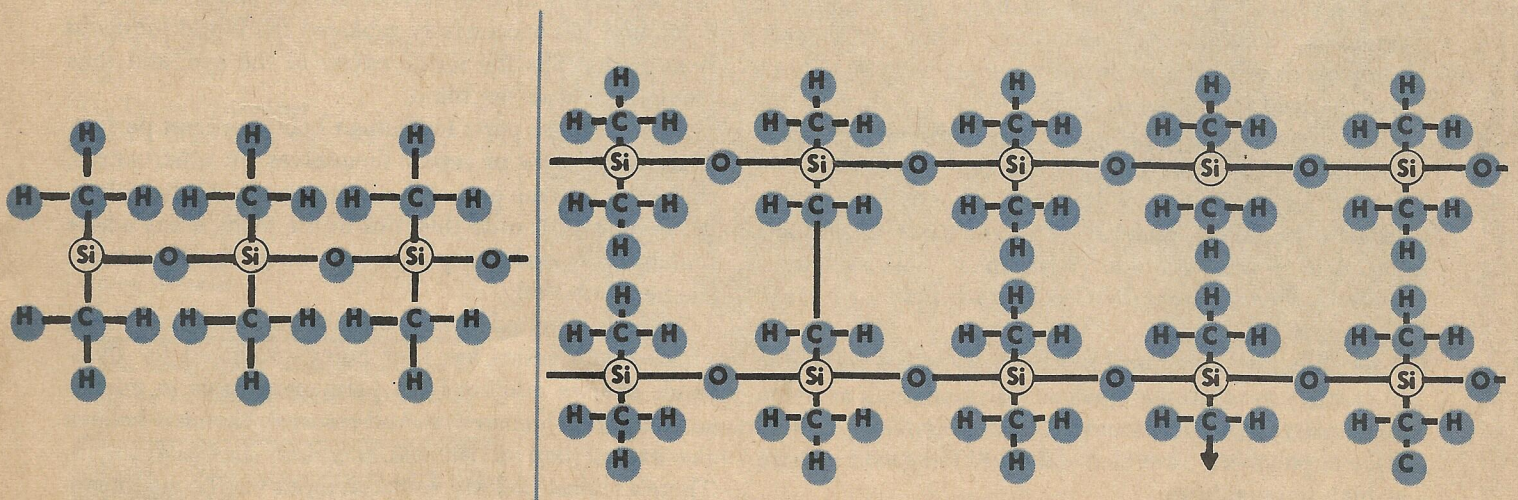


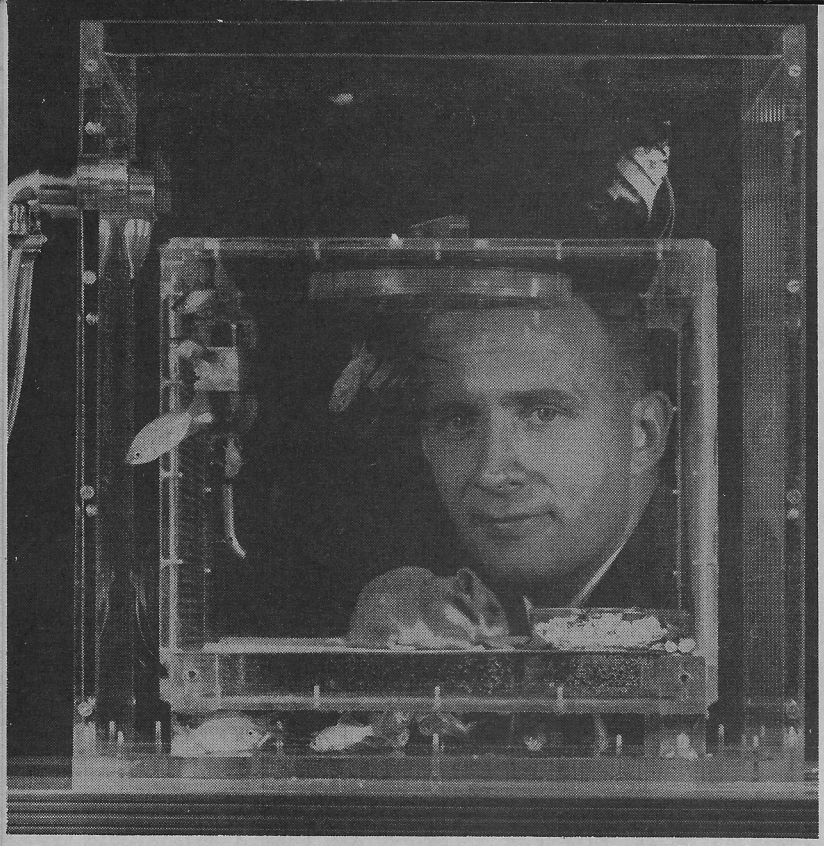
General Electric Co. photo

This waterproof, weatherproof roof of silicone rubber can be rolled on in less time than it takes to nail down a dozen shingles. Yet it will last at least thirty years.



Senior Science graphic

Silicones consist of silicon (Si) and oxygen (O) atoms linked in repeating chains with carbon molecules (in this case CH_3) linked to silicon atoms. Short, simple chain at left is a "thread" molecule of silicone oil. Chain of silicone rubber (right) contains all the same atoms, but the arrangement is more complex, and each chain is linked to another by a carbon-carbon bond.



General Electric Co. photo

Though held below water, "aquahamster" is kept alive by "gill" of thin silicone rubber stretched around its home. "Gill" extracts air from water, and keeps hamster dry.

Silicone Chemistry *continued*

bond between silicon and carbon is very strong, and relatively chemically inert, like the carbon-carbon bond. (See "Harder Than Diamonds," *Senior Science*, Oct. 5, 1967.)

These were startling discoveries. But nothing was done with *organosilicon* (carbon and silicon) compounds. They remained laboratory curiosities for the next 75 years. It required World War II to take them out of the lab and put them to work. Scientists in search of new war materials jumped at the possibility of combining the qualities of rubber, mineral oil, and plastic (carbon-based materials) with those of glass, sand, and ceramics (silicon-based materials). They succeeded: They produced substances with the flexibility of rubber and the heat resistance of glass.

How was this strange marriage performed? Scientists had known for some time that certain natural organic substances – rubber, wood, cotton, resin, gelatin – consisted of long chain molecules of carbon and other atoms linked in repeating units. These chain molecules were named *polymers*, from the Greek words *poly* for "many" and *meros* for "parts."

By studying the natural polymers, scientists were able to create several strong artificial polymers such as nylon and Lucite. However, these artificial polymers – like all organic polymers – are heat sensitive. They melt or burn at high temperatures.

Silicon, like carbon, has the bonding ability to form into chain molecules. So scientists decided to combine the toughness of inorganic silica with the flexibility of organic plastics. They crosslinked organic groups of atoms to chains of silicon and oxygen atoms, thus producing *silicones*. In so doing, they created a new branch of chemistry – silicone chemistry – which is neither organic nor inorganic.

Organic chemists from the Dow Chemical Company and inorganic chemists from the Corning Glass Works were grouped to form the Dow Corning Corporation for the sole purpose of producing silicone materials, in March, 1943. General Electric Company and Union Carbide Corporation joined the field shortly thereafter, and the silicone industry was on its way. Today, that industry is huge.

Silicones, because of their extremely strong but flexible chemical bonds, can resist the effects of heat, cold, age, many chemicals, weather, sunlight, and water better than most materials known to man. And they're not affected by any living organism – they're immune to attack by bacteria or fungi. Neither does their presence interfere with life.

"Spare Parts" for Humans

Silicone devices can be placed in the human body without causing damage or producing a dangerous response. No other materials are completely suitable for this use. Organic materials are too much like the body's substances; as a result, the body's defenses tend to reject them as foreign matter. Certain metals cause very little foreign body reaction. But they're hard and unyielding, and tend to damage surrounding tissue and organs.

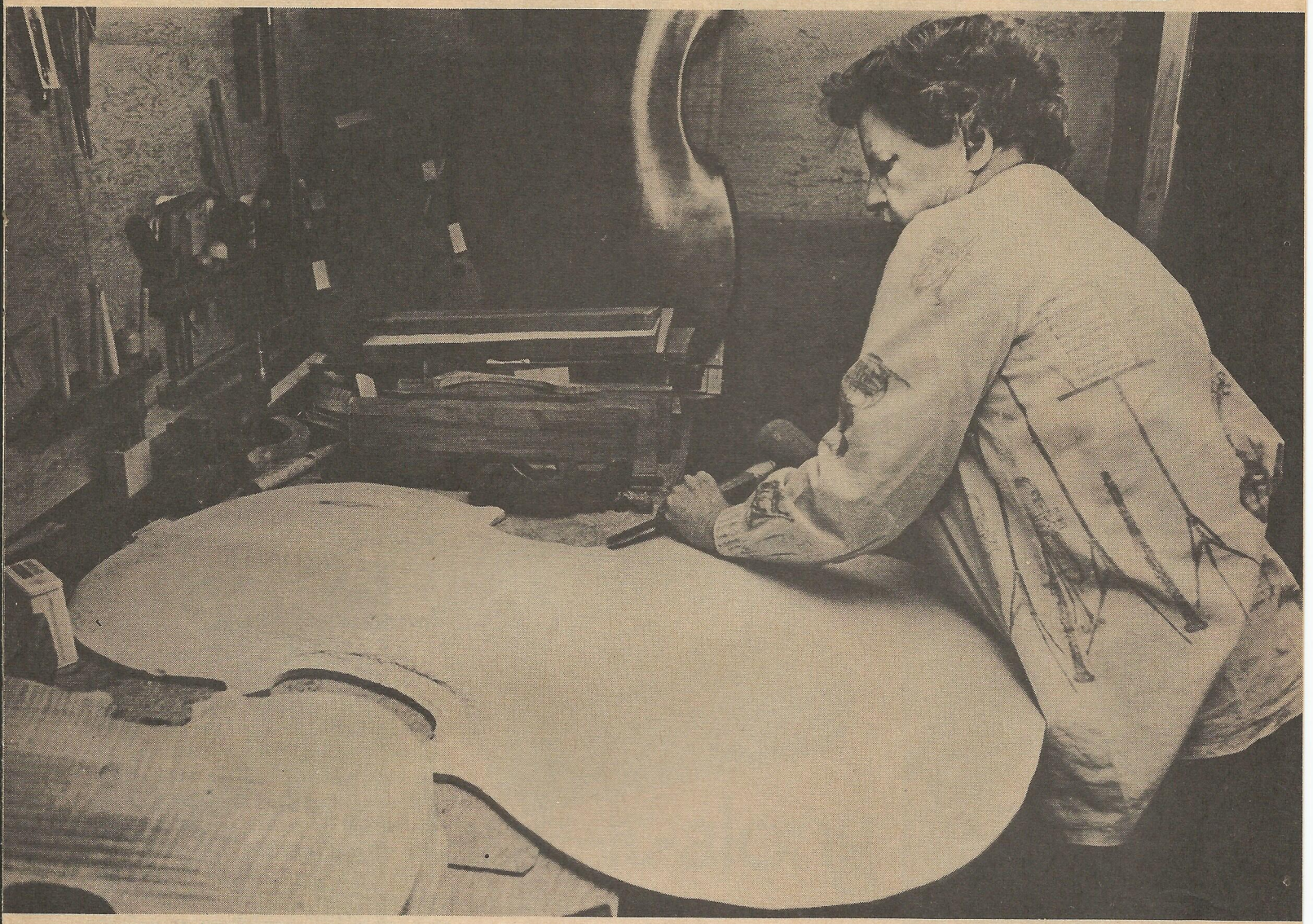
Silicone devices are soft and yielding. And they don't alert the body's defenses. Why not? Possibly because silicones are so unnatural that the human organism never had to evolve defenses against them. Scientists don't endorse this reasoning completely; it hasn't been scientifically demonstrated. No other theory, however, has been advanced to account for the phenomenon.

Silicone tubing is used to replace damaged arteries, and silicone film is used to replace certain membranes. Silicone fluid has successfully replaced the liquid *(aqueous humor)* that fills the inside cavity of the eye, and thus restored sight to the blind.

Silicone spare parts for human beings are not perfect. They don't grow or repair themselves. In other words, they can't become part of the living system. Only biological organisms can do this. But in the many areas where human or animal transplants can't be used, silicones are the next best thing.

Several hundred types of silicone rubbers, fluids, greases, and resins are now being produced for thousands of uses ranging from permanent roofs to minute sections for a human eye. And research chemists believe the exploitation of silicone chemistry has just begun. There's almost no limit to the number of silicone molecular arrangements that can be produced in combination with various elements. Who knows what incredible compounds the future will bring?

— Michael Cusack



Carleen Maley Hutchins
She Fiddles with Fiddles

Expertly chiseling the back of an instrument, science teacher Carleen Hutchins is exploring the secrets of violin-making.
Photo from Bruce Frisch

VIOLIN-MAKING as an art reached its peak in Cremona, Italy, in the 17th and 18th centuries. But only within the last few years has it become a *science*. Where? In the shop and lab of Carleen Maley Hutchins in Montclair, N. J.

"Don't get the idea this is all mine," she cautions. "Not by a longshot. I'm the go-between between the scientists and the fiddlemakers. I have enough wits to understand them both."

The secrets of Stradivari (probably the finest violin maker of all time) began to fall with a project of Dr. Frederick Saunders, head of the physics department at Harvard University. He set out in the 1930's to discover what made a $50,000 violin sound better than a $5 one. His first questioning of experts revealed an incredible, centuries-long accumulation of mumbo-jumbo.

"Some really intelligent people said that their violins could be improved by allowing the instruments to 'listen' to a Heifetz concert," he later recalled. The truly desirable qualities in a costly violin seemed to be "Italian tone color" and loudness.

Dr. Saunders knew tone color meant the mixture of frequencies sounded by the violin. The entire length of a violin string vibrates as a whole at a certain frequency – called the fundamental – to sound the note called for by the sheet music. At the same time, it vibrates twice as fast in two sections, three times as fast in three sections, and so on. These frequencies are called *overtones*.

But the string itself makes no more music than the beating of a gnat's wings. Why? Because it moves a tiny volume of air. And it is moving air that

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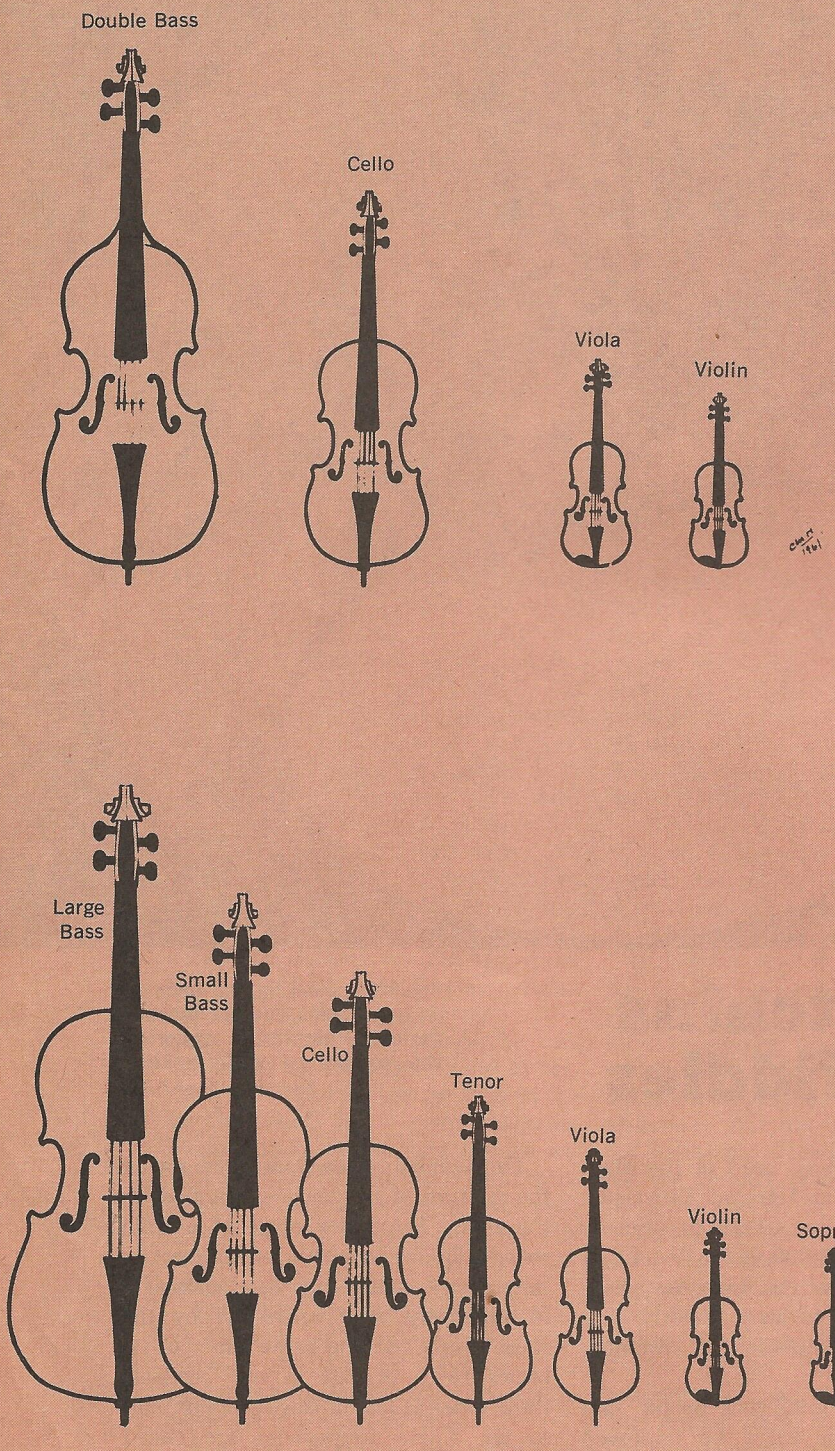


Drawing by C. M. Hutchins

Starting with the original family of four violin-type stringed instruments at top, Dr. Frederick Saunders and Mrs. Carleen M. Hutchins developed and built a new group of eight instruments that more nearly equals the range of a piano. Smallest is two sizes smaller than a violin, largest is bigger than a bass viol.

constitutes sound. The string must cause the wood panels of the violin to vibrate in order to move a larger volume of air. The panels vibrate strongly at only some of the frequencies fed to them by the string. (The strongest of these frequencies is called the *resonant frequency.*) The resulting mixture of selected overtones is what makes a good violin sound better than a cheap one. And this characteristic mixture is what makes the violin sound different from the cello, trumpet, or voice.

Dr. Saunders proceeded scientifically to analyze the sound of about 70 violins, including seven "Strads." His principal technique was to have the violin expertly bowed before a microphone. The sound was fed to instruments that measured the loudness of all frequencies from about 10 to 10,000 cycles per second.

Inventing New Strings

The best violins turned out to have three loudness peaks. One, corresponding to the resonant frequency of the wooden body, matched the tone of the second highest of the four strings. The second peak matched the resonance of the air inside the violin. This tone can be heard by blowing across one of the openings in the body, called f-holes, just as you would blow across the mouth of a bottle. A larger violin air cavity had a lower resonance, in the same way that a cider jug sounds lower than a pop bottle. In good violins, the tone of the second peak was that of the third string.

The tone at one-half the frequency, or one octave below the body resonance, was not particularly strong, but the loud body resonance, which was its first overtone, made it seem so, and beefed-up low notes.

Combined, the three well-spaced peaks gave a good violin fairly uniform loudness over its whole range.

While Dr. Saunders was finishing these tests, Mrs. Hutchins, a science teacher in a New York City private school, took up the viola. "I wanted a better one than I had, and couldn't afford it, so I spent two years making one," she says. It was sneeringly pronounced "the work of a good carpenter," says Mrs. Hutchins, but it must have shown

Continued on page 20

tomorrow's scientists

PROJECT: Effects of Temperature on Drosophila Life Cycle Stages

RESEARCH BY: **RICHARD JOHNSTON,** WINNER, FORD-FUTURE SCIENTISTS OF AMERICA AWARDS
SCHOOL: AMHERST CENTRAL JR. H. S., SNYDER, N. Y. TEACHER: **WILLIAM C. RITZ**

SINCE 1909, the common fruit fly *(Drosophila melanogaster)* has been used extensively in studies of heredity. Over the years, probably more has been learned about the basic laws of heredity from work with this tiny insect than from work with all other organisms combined.

The fruit fly is particularly suited for this study because (a) it takes only 10 to 20 days to mature from egg to adult fly, (b) its small size makes it easy to culture, handle, and store – yet many characteristics, such as eye color and wing shape, can be easily observed, and (c) one pair of parent flies can produce hundreds of offspring.

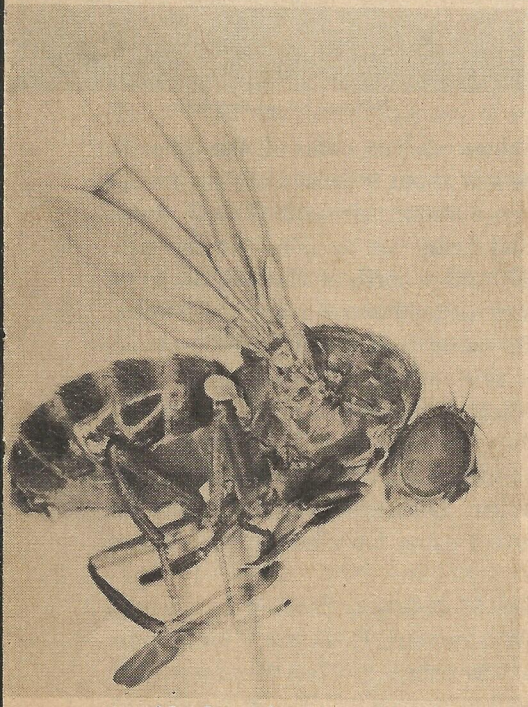
Richard's Purpose

Of course, there are disadvantages too. One is that variations in temperature affect the length of time it takes the fruit fly to pass through each stage of its life cycle. The purpose of Richard's project was to determine the extent of this temperature effect.

Length of Life Cycle Stages

Fahrenheit Temperature	Larval Stage	Pupal Stage	Adult Stage
50°	———	———	———
60°	———	———	———
65°	8th—18th	18th—35th	35th—40th
70°	7th—16th	16th—21st	21st—26th
75°	6th—15th	15th—20th	20th—26th
80°	4th— 8th	8th—14th	14th—20th
85°	3rd— 7th	7th—13th	13th—17th
90°	———	———	———

lengths of stages in days ——— flies did not survive



Manuel Dos Passos, from National Audubon Society

THE COMMON FRUIT FLY: Richard found that variations in temperature have a definite effect on the length of its life cycle.

His Method

Richard obtained 15 adult flies. These he cultured on a standard nutrient medium. They produced 60 offspring in about two weeks time. He divided the offspring into six groups. He then placed six culture bottles, each containing ten flies, in six locations around his house – at 50°F, 60°F, 70°F, 80°F, 85°F, 90°F.

Richard's Results

Richard did not have to wait very long for results.

After only three hours, all the flies in the bottle at 50°F were motionless. He moved this bottle to a 65°F spot.

After seven hours, all the flies in the 60°F bottle were motionless. He moved this bottle to a 75°F spot.

After 48 hours, the food in the 90°F bottle had dried up and all the flies were dead.

After making these "moves", Richard ended up with bottles at 65°F, 70°F, 75°F, 80°F, and 85°F. Now all he could do was wait and watch. In his project report, Richard recorded the length of time required for the fruit flies to pass through each stage of their life cycle – from egg to larva to pupa, and from pupa to adult *(see chart)*.

His Conclusions

From his results, Richard concluded that the flies cannot live at temperatures under 60°F or over 90°F for long periods of time. The flies that grew at 65°F required the most time to pass through their life cycle stages. Also, this group produced only seven or eight offspring.

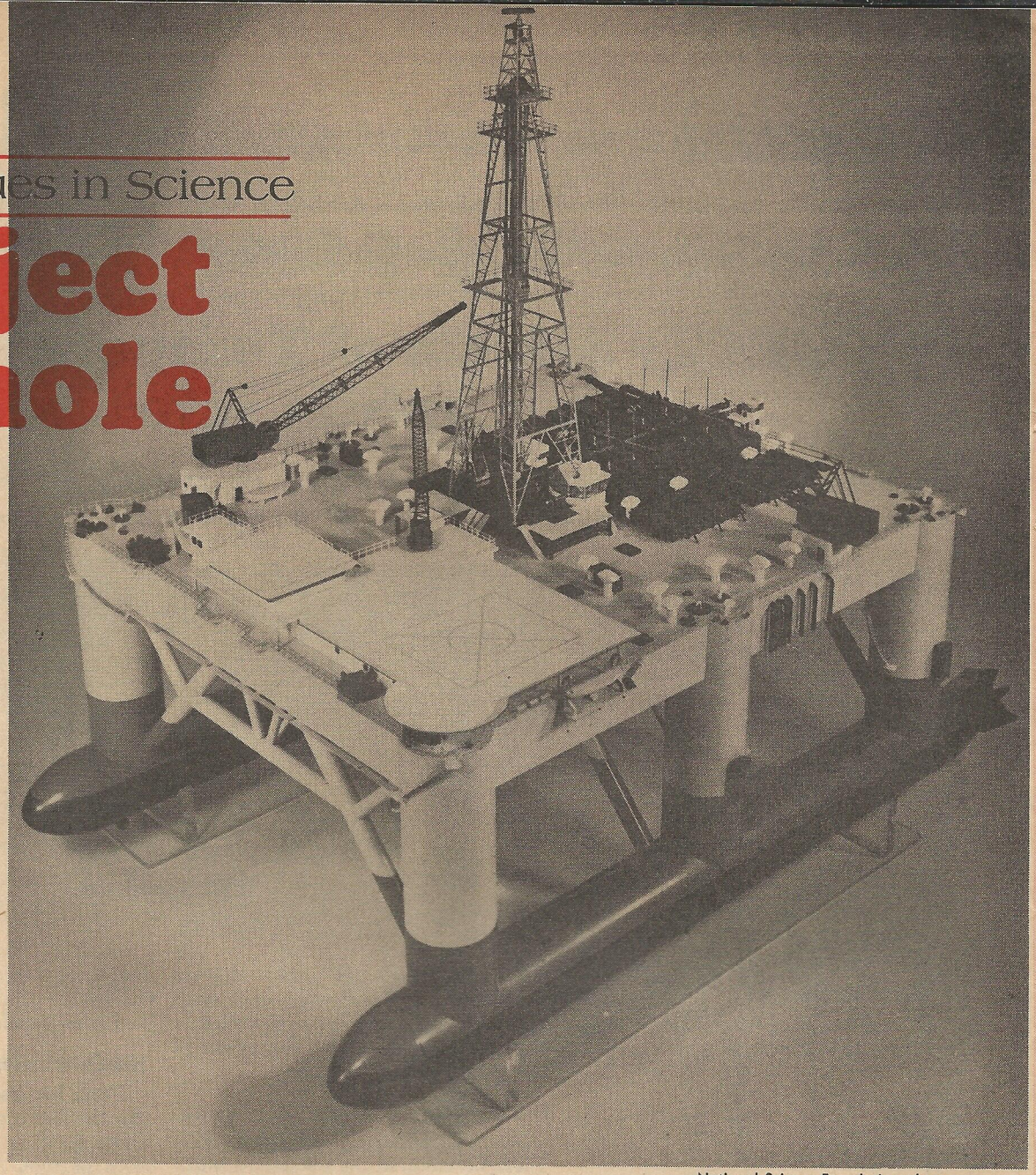
Richard also observed that the higher the temperature, the less time it took for the fly to reach the adult stage. Actually, the egg to larval stage was shortened most. Although there seemed to be little difference in the durations of the larval to pupal stage and the pupal to adult stage at the various temperatures, the egg to larval stage was five days longer at 70°F than at 85°F.

Interestingly, the pupal to adult stage was almost the same at 65°F as at the other temperatures. But the larval to pupal stage at 65°F was about three times longer than at the other temperatures.

Finally, Richard was aware of a variable in his work over which he had no control. He had no way of controlling the temperature changes that must have occurred in the locations from night to day, day to day, and week to week.

Critical Issues in Science

Project Mohole



This deep-sea drilling rig, shown in model, was to drill the Mohole. Actual rig was never constructed.

National Science Foundation photo

THE WATER is deep, the sun is hot, and the work is hard. Gargantuan is the word for this project: drilling the world's deepest undersea hole – more than 17,000 feet – under some 14,000 feet of blue Pacific water.

The name of the game is Project Mohole. It's not a hunt for world's records; it's a serious scientific project. When it was proposed in 1956, the idea fired the imaginations of scientists and laymen the world over.

Unfortunately, Project Mohole will not be completed in 1968. Nor in 1969. Nor ever – at least in the immediate future. Why not? The project was killed by Congress in August 1966. But the memory – and the controversy – lingers on.

Why was Project Mohole proposed in the first place? To explore a part of the Earth no man has ever seen – the *mantle.* The Earth's outermost layer, the *crust,* has an average thickness of 10 miles. This is a mere 400th of the Earth's radius. Beneath the crust, and surrounding the Earth's core, is the 1,800-mile-thick mantle. It accounts for more than 80 per cent of the planet's volume, yet we know less about it than about the moon!

How to find out more about the mantle? Drill down through the crust and bring up samples. At the proposed drilling site, 100 miles north of Hawaii, the crust is only 17,000 feet thick, instead of the average ten miles.

The project got its name from Andriji Mohorovicic, who was a Yugoslav seismologist. His studies of earthquake waves first indicated that the rocks of the mantle were denser than those of the crust. This density difference marks the boundary between crust and mantle, called the Mohorovicic Discontinuity, or Moho for short. Hence the perfect name for a hole to the Moho: Mohole.

The idea for Project Mohole was hatched by a group of geophysicists in Washington, D. C. They were influential, and the idea was exciting. Thus it was easy to get federal money for preliminary studies on the project.

Such studies are customary for any large, expensive undertaking – such as Mohole, which was to cost sev-

eral million dollars – whether by government or by industry. Studies themselves cost money, but help answer important questions: Is the project possible? What are its real objectives? How much will it cost? Will the results be worth the cost? What scientists and what organizations (universities or large industrial concerns) are equipped to participate in such a project?

These questions, and more, were answered to the satisfaction of the National Science Foundation, which funded the studies. According to plan, it was decided to try out some Mohole drilling ideas on a small scale.

All went well. A converted 260-foot Navy barge, called CUSS I, was used for a drilling platform. CUSS I used an ingenious system of outboard motors located along its hull to help it stay in place over the drilling site. CUSS I drilled a record-breaking 601-foot hole in the muddy ocean bottom – in water more than two miles deep!

CUSS I marked the last unqualified success for Mohole. By this time, $1,250,000 had been spent on CUSS I, and a few hundred thousand on the preliminary stages of Mohole. Now it was time for the next move – competitive bids from interested companies and universities.

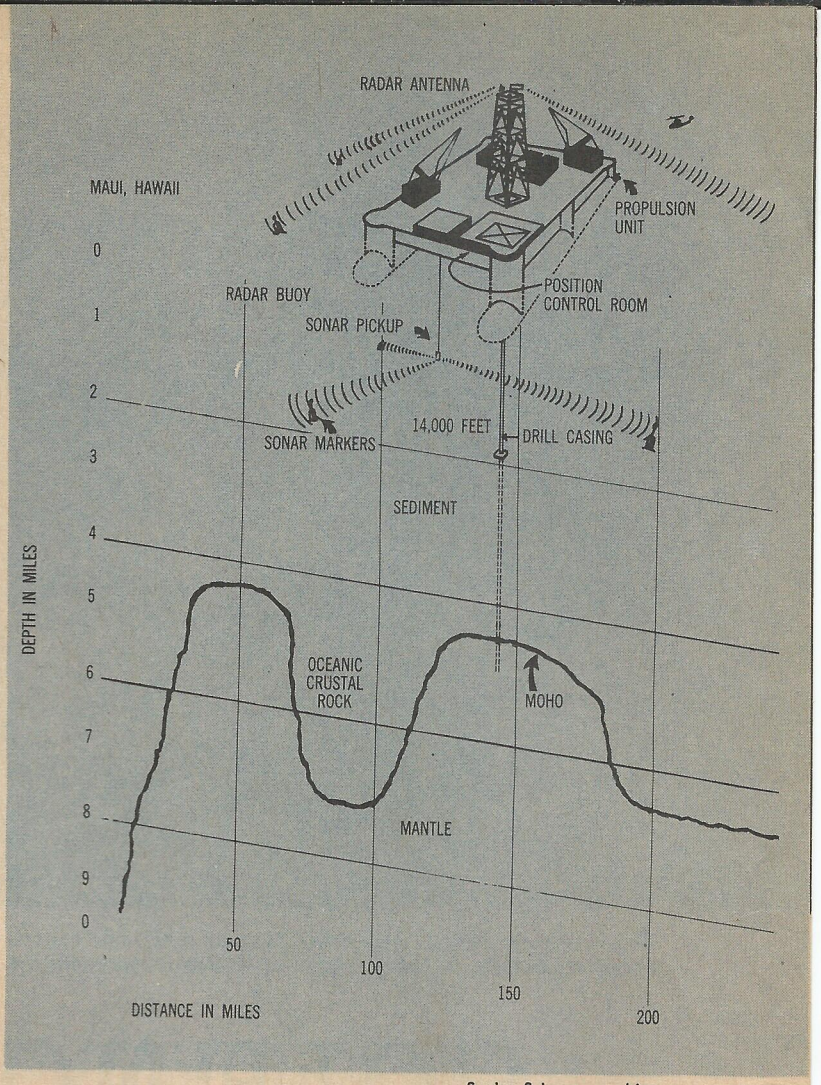
The bid was awarded to a Texas engineering and construction firm, amid much controversy. (Hints of scandal, voiced by a congressman, finally put an end to Mohole. But, according to Daniel S. Greenberg, who has reported the details of the Mohole affair in his new book, *The Politics of Pure Science*, there was no real basis for the charges.)

For a multi-million-dollar fee, the engineering firm came up with the plans for a 10,000-ton floating platform, 234 feet by 250 feet. The platform was to be supported by submarine hulls, driven by propellers, to keep the platform in place. The cost? Anywhere from $18 million to $25 million.

It was here that Congress began to ask questions, and scientists began to disagree in public. They had already been disagreeing privately among themselves.

One group of scientists felt that construction of the drilling platform should be keyed to the deep Mohole. But another group felt that, although much information about the Earth could be gathered from the Mohole, it would be merely one isolated engineering feat. They felt that more valuable information could be gathered by drilling many holes in the seas all over the Earth, first through the soft sediments, and then through the rocky crust beneath this muddy bottom. This approach would take years, but the scientific information as well as the drilling experience gained through "going slow" would be worth the time. The arguments were stilled, at least for a while, when Congress killed the project.

Was the Mohole affair a total fiasco? Most observers say that the answer is no.



Senior Science graphic

Diagram shows how Mohole drilling rig was to have worked. Radar and sonar devices were to be used to keep drilling platform in position over the hole site in deep water.

First, much of the technology developed by the engineers planning the Mohole project will be used in future drilling operations. As a matter of fact, one firm is now marketing guidance devices for positioning ships and drilling platforms over a given point at sea. These systems were originally developed for Mohole.

"To drill on the deep-sea floor is an eminently worthy scientific project," said a renowned earth scientist, with regard to Mohole. He, along with others, knew that the over-all intentions of Mohole – to explore the Earth's interior – were sound. Now, hopes are high for a new, less daring project called JOIDES (for Joint Oceanographic Institutions Deep Earth Sampling). JOIDES is now doing deep-sea coring in muddy ocean bottoms all over the world.

The lesson to be learned from Mohole is that science does not thrive merely on breakthroughs, no matter how spectacular they may appear. The development of a technology to drill Moholes will eventually come. Until then, dedicated earth scientists go about the hard and serious work of drilling in the sea's ooze and analyzing their findings. The dream of a hole in the bottom of the sea must wait, but it surely will come true, sooner or later.

— Robert L. Wersan

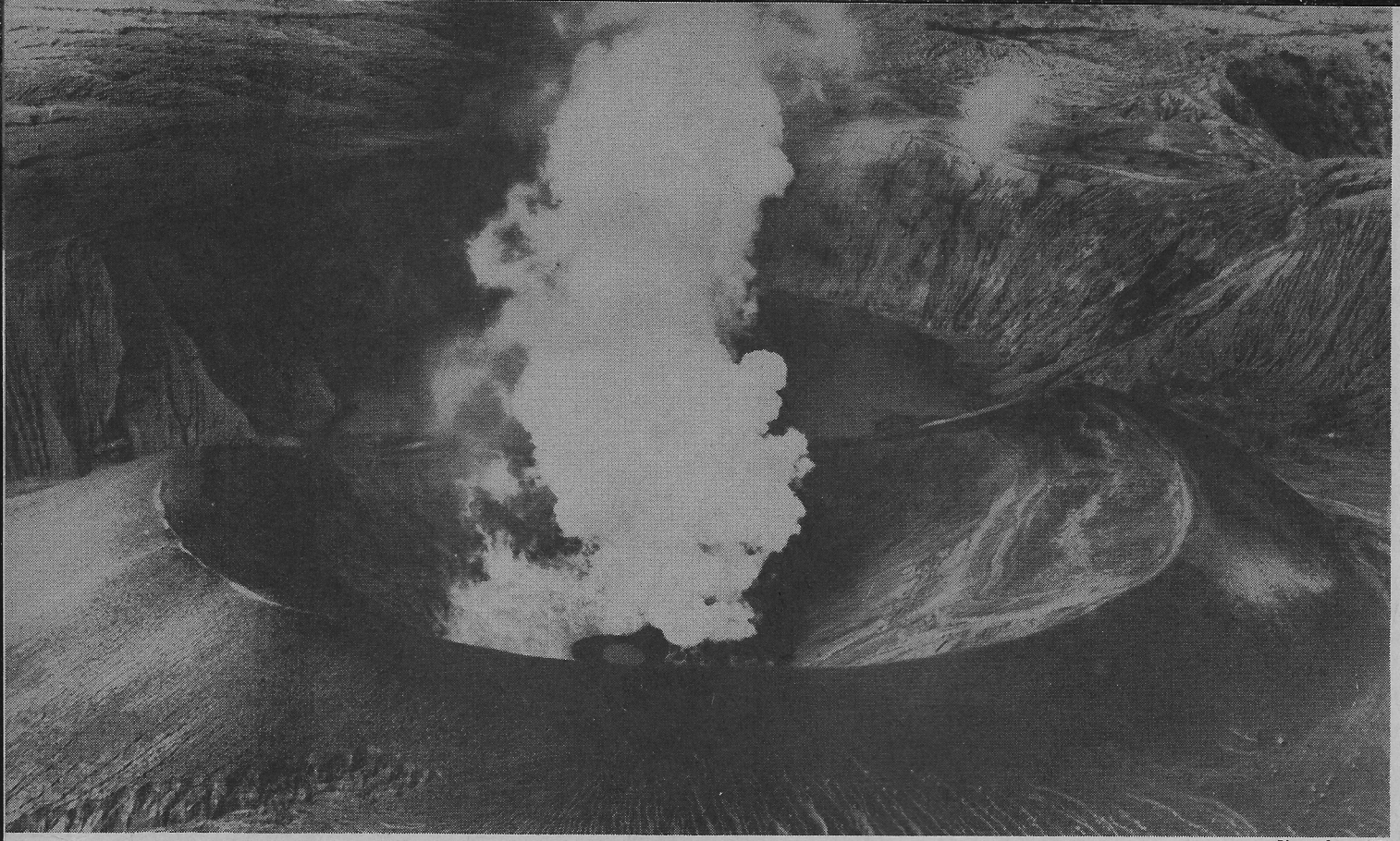


Photo from UPI

This is what you would see looking down on a boiling Taal volcano near Manila, in the Philippines. Its recent eruptions exploded ash-laden clouds skyward. Some 30 families had to be taken out of the area when the volcano became active.

SCIENCE IN THE

Polar Bear Census

The wide-ranging polar bear knows no international boundaries. It wanders across the icy wastelands of five countries – Denmark, Canada, the USSR, Norway, and the United States.

Scientists from these countries will pool their efforts this year to tag the white bears. This will be the first step in a planned polar bear census. Right now, scientists think that the total polar bear population numbers anywhere from 8,000 to 20,000.

About 1,300 to 1,400 polar bears are killed each year. This includes 200 to 400 bears that are hunted in Alaska, where guides may charge as much as $2,000 for a polar bear safari.

U.S. scientists say that, until now, no accurate method of counting the bears has been devised. One difficulty in polar bear census-taking is that the white bears blend in with the snow and are difficult to spot. Also, polar bears move around quite a bit – traveling 30 to 50 miles a day on floating ice packs. Scientists hope that, by taking an international count, they will find out just how many polar bears are moving in Arctic circles these days.

DDT Hazard to be Reduced

Carrots, spinach, strawberries, and 33 other fruits and vegetables may taste the same next year as they do now – but there will be a difference. Farmers will be required to cut the amount of DDT remaining on crops after harvesting. Right now seven parts per million of DDT is allowed on many garden crops. The Food and Drug Administration and the Department of Agriculture plan to allow an insecticide residue of only one part per million in 1969. This action, say government officials, will cut down on any possible health hazards from DDT.

Space Sounds

"Hello, Wally, this is Jack Jones, Wally; It's so nice to know you're up where you belong." Hum that along to the tune of "Hello, Dolly!" and you'll get an idea what the "space sound" was for Gemini flight astronauts. The National Space and Aeronautics Administration revealed recently that the song was one beamed to Captain Walter Schirra on his Gemini VI cruise.

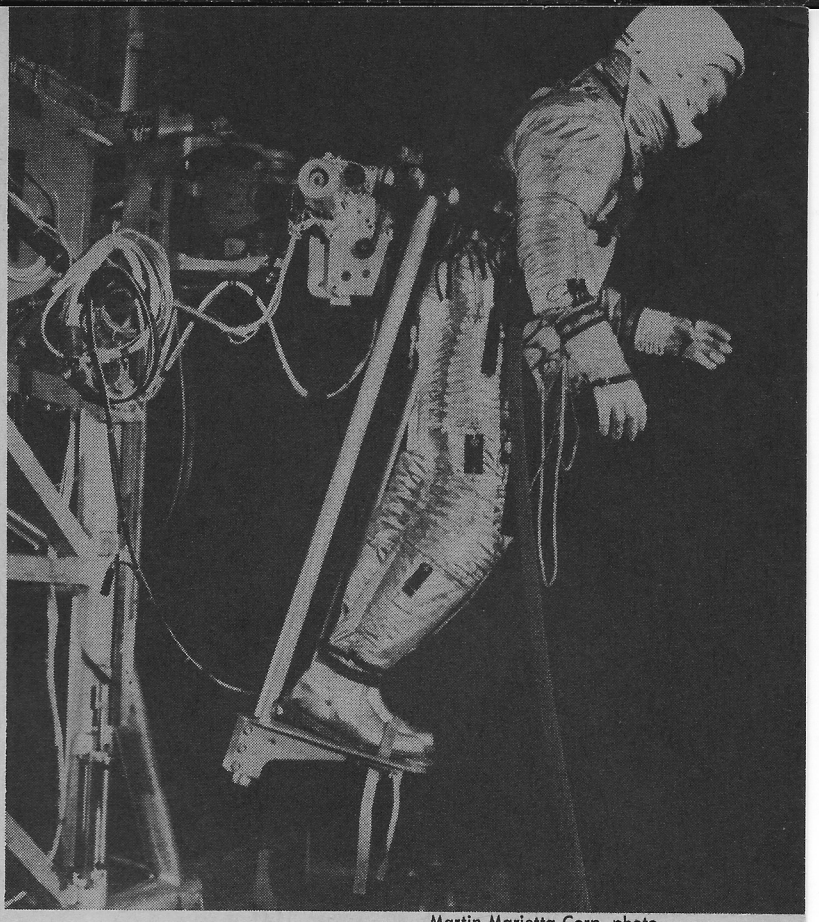
NASA also reports that Captain Schirra and his teammate, Major Thomas P. Stafford, beamed back their space rendition of "Jingle Bells" for earthlings at the Houston space center. The U.S. disclosed its musical exchanges with space crews after the Russians announced that they had tested radio transmitters from an unmanned spacecraft with a recording of the 110-voice Pyanitsky Choir. The Russians used the choir recording so that no one would accuse them of sneaking a manned spaceship into orbit.

Cosmic Rays to Search for Mummy's Tomb

A team of Egyptian and American scientists plans to use cosmic rays to explore the great Khefren Pyramid at Giza, Egypt. The object of their search is a burial chamber believed to lie hid-

Photo from UPI

Maryknoll priest from Freeport, Minn., Father Daniel F. Ohmann, works a solar cooker for parishioners in Tanzania.



Martin Marietta Corp. photo

A special device measures the typical movements of an astronaut. Scientists need such information for spacecraft design.

NEWS

den within the 4,000-year-old pyramid. Burial chambers have been found in the other pyramids at Giza.

By measuring the passage of cosmic rays through sections of the pyramid, the scientists expect to be able to tell which part of it is hollow. Cosmic rays are high-energy particles traveling in from space. They strike, penetrate, and sometimes pass through objects in their path. However, dense material, such as rock, tends to block their passage. The more rock in the way, the fewer cosmic rays get through.

With cosmic ray detectors in a vault beneath the pyramid, the scientists can plot the passage of the rays through its various parts. If a part is hollow, many more rays will get through.

Icy History "Book"

An eight-man team of Army Engineers has succeeded in drilling completely through the Antarctic ice cap. As reported by "*Science in the News*" in February, the long ice cores from the hole will provide scientists with a vertical profile of polar history – a "window" into the Earth's past.

After six months of drilling, the group from the Army's Cold Regions Research and Engineering Laboratory hit paydirt 7,111 feet below the surface of the ice. This is a depth of nearly one and one-third miles. The last 18 feet of the ice core consisted of dirty ice and gray and black rock fragments up to two and one-half inches in size. These are apparently of volcanic origin.

The cores from the ice cap – which contains 90 per cent of all the fresh water in the world – will give scientists information on the composition of the Earth's atmosphere tens and perhaps hundreds of thousands of years ago. They hold air trapped in the ice long ago. The cores will also throw light on other events of the past – the rate of snow accumulation, polar temperature changes, and the rate of deposition of meteorite particles.

Silent Wings for Science

The enemy is invisible – like the air. In fact, the enemy is air, moving turbulent air that cannot be forecast because it is not found in the vicinity of storms. For this reason, it is called *clear-air turbulence,* or CAT for short.

CAT usually sneaks up on high-flying aircraft – above 20,000 feet – to suddenly and violently jolt and buffet them. As a result, many airline passengers have been shaken up or injured by CAT. CAT has been suspected as the cause of several aircraft crashes during the past few years.

Now a new method has been tested for detecting CAT. During the past months, an instrument-laden, engineless *sailplane* – some call it a glider – has been making measurements in turbulent air. Piloted by Captain Kimball J. Scribner, an airline pilot, the sailplane has made a series of 30 flights in the vicinity of Mt. Washington, in New Hampshire.

Mt. Washington is a 6,288-foot-high peak, the tallest in the northeast. Eddies and currents of air are deflected and magnified in the mountainous area. The effect is identical to the CAT found at high altitudes. An instrument checks the temperature in the air ahead of the sailplane. Other equipment measures the intensity of the electric field in the air. The sailplane is considered a perfect flying laboratory for these studies because, as it flies, it becomes part of the air mass surrounding it, much like a balloon.

PROJECT POINTERS

Experimental Embryology with Chick Eggs

THE HATCHING of a chick from its hide-a-way in the egg is merely the finale of a fascinating process – differentiation. Differentiation produces a complex many-celled animal from a single cell – the fertilized egg. (See "Slime Molds," *Senior Science,* February 29, 1968.)

You can learn many of the secrets of the developing embryo in your own school or home laboratory. Chick embryos are not only easy to get, they are convenient to work with. Their normal period of development is three weeks.

Do your work in two stages. First, familiarize yourself with the normal development of the embryo, by daily laboratory examination. At the same time, you will be mastering the techniques you'll need for the second stage – studying the effects of variations in the environment of the growing embryo.

An incubator is needed. If none is available, you can easily build one. Or, an incubator designed for bacteria culture may be used.

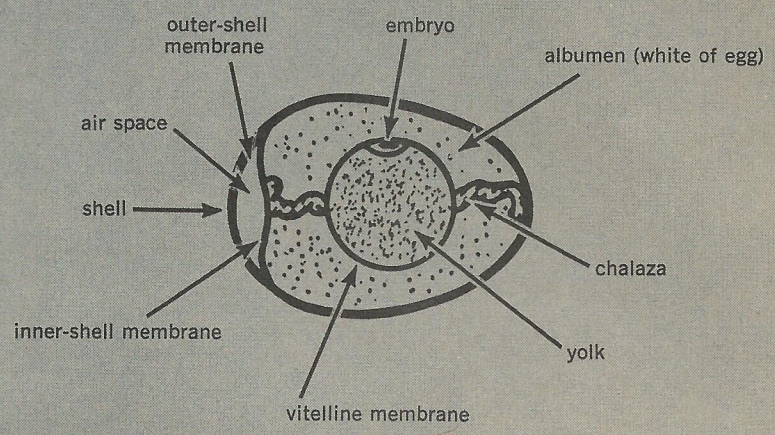
Obtain 10 (or more) fertilized eggs from a chick nursery or chicken farm. As soon as possible, place the eggs in the incubator. (Fertilized eggs can be stored before incubation at temperatures of 10°-15°C only.) Maintain the incubator at 37°C. Suspend the thermometer in the incubator, keeping the bulb level with the eggs. (Why?)

Keep the relative humidity at about 60 per cent by placing a few dishes of water in the incubator. Replenish the water as it evaporates.

Do not wash the egg surface. Washing can remove a protective film that prevents bacteria from passing into the egg. Turn the eggs daily to prevent adhesion of membranes to the shell. You can mark the eggs with a pencil to keep track of which side is "up."

After about 36 hours of incubation, remove an egg from the incubator, being careful not to turn it. Gently crack the egg and pour its contents into a finger bowl containing physiological saline (salt) solution, warmed to 37°C in the incubator. Make this solution by dissolving 0.9 gram of sodium chloride in 100 ml of distilled water. The embryo should be submerged in the solution.

Egg Structures at Early Stage of Embryo Development



Examine the embryo with a hand lens and under a binocular microscope. Record your observations. What structures are identifiable? Is the heart beating? Is blood circulating?

Using a different egg each time, repeat your observations at 40, 45, and 50 hours of incubation and again when the embryo is 3, 7, and 14 days old. Permit a few chicks to develop to hatching.

For various reasons beyond your control, some of the eggs will not develop embryos. Determine the proportion of such eggs to eggs that mature. Also determine the mortality rate of the embryos that do develop – that is, find the number of embryos that die before hatching. Run a batch of 10 fertilized eggs through an entire 21-day cycle to determine this figure.

You should now have an idea of what a normal embryo looks like at various stages of development. You should also know roughly what proportion of unfertilized eggs you can expect, as well as the normal mortality under your experimental conditions.

With this "standard" data under your hat, you have a basis of comparison for further investigations. Here are a few suggestions for varying the environmental conditions:

1. Incubate one batch of eggs at any constant temperature between 39°C and 45°C. If you have the time and money, run a few batches at various temperatures above 37°C. What happens if you place an egg in a refrigerator or freezer at various stages of embryonic development and then return it to the incubator?

2. Apply a coating of wax over the entire surface of the egg shell. How does this affect embryo development? Can you explain your results?

3. At various stages of development, tape eggs to the outside edge of a phonograph turntable. Rotate at 78, 45, and 33⅓ rpm for various periods of time (always returning the eggs to the incubator).

4. Place eggs at various stages of development in different parts of a magnetic field. The field pattern can be found by sprinkling iron filings on a sheet of paper placed over the magnet. Use a strong magnet; vary the time of exposure.

5. Do not place dishes of water in the incubator. What is the effect of low humidity on embryo mortality?

6. Do not rotate the eggs. What happens?

Remember always to provide appropriate controls. If you remove eggs from the incubator for various periods, for example, you must also remove untreated eggs for the same periods. The more eggs you use, the more reliable your results will be.

— ALEXANDER JOSEPH

SCOREBOARD

How well have you read your *Senior Science*? Answers to questions with no asterisks may be gleaned directly from the articles. Answers to questions with an asterisk (*) require fusing the facts in the articles with those learned in the classroom or from your reading. Answers are in the SCOREKEEPER on page 19.

I. Silicone Chemistry

_____1. Without knowing the chemistry, the ancient Egyptians produced and used silicones.
_____2. Carbon is chemically more active than silicon.
_____3. The silicones fall into neither organic nor inorganic chemistry, but rather can be considered to be a separate branch of chemistry.
_____4. The ability to form polymers is characteristic only of substances that exhibit covalent bonding.
_____5. Silicon is never found free in nature.
_____*6. Silicon is the third most common element in the Earth's crust.
_____*7. Because of their covalent bonding, carbon, silicon, and germanium are classed as semiconductors.
_____*8. There are more known compounds of carbon than compounds of all the other elements combined.

II. Today's Scientists

_____1. The quality of a note produced by a violin depends solely upon the number of overtones produced by the vibrating strings.
_____2. The resonant frequency of an object is the same frequency as that produced by the object when it is struck or otherwise set in vibration.
_____3. The difference between a note played by a violin and the same note on a trumpet is largely a difference between the number and relative intensity of the overtones produced.
_____4. In the best violins, the loudness peak produced by the resonance of the body is at the same frequency as the resonant note produced by the air column.
_____5. It is impossible to predict what the loudness peaks of the violin body will be until the entire body is assembled.
_____6. Recently, violins have been made whose quality of note is vastly superior to that produced by the violins of the old Cremona school.
_____7. An air chamber resonates at a lower frequency if its openings to the outside are made larger.
_____*8. The quality of a violin note can be markedly changed by changing the point on the string at which it is bowed.
_____*9. Most scientists would agree that the type of shellac covering the violin body influences the quality of the note a violin produces.

III. Critical Issues in Science

_____1. The Earth's mantle accounts for more than 80 per cent of the Earth's volume.
_____2. The density of the rock in the mantle is, on the average, less than that of the crust.
_____3. The average thickness of the Earth's crust is about one-tenth of the Earth's radius.
_____4. The Mohorovicic Discontinuity was discovered from evidence revealed by the drilling of deep oil wells.
_____5. Studies have not yet been made on the feasibility of drilling the Mohole.
_____6. Man has already drilled more than one-third the way through the crust at its thinnest point.
_____7. Most scientists agree that all the technology needed to drill the Mohole is presently available and that it should be dug immediately.
_____*8. Scientists are uncertain as to the exact state in which matter in the mantle exists.

Going Beyond

How much do you know about the physics of music? See if you can answer the following true-false questions.

1. By international agreement, the note A – to which the orchestra is traditionally tuned – is set at 440 vibrations per second.
2. A good violinist causes a smooth, periodic vibration of about 6 cycles per second in the amplitude and frequency of any sustained note.
3. A note one octave above another has twice the frequency of the other.
4. The highest note on a piano has a frequency of just over 4,000 cycles per second.
5. With the exception of a very large pipe organ, the piano has the greatest range of fundamental frequencies of all the common musical instruments.
6. Of all the percussion instruments, the glockenspiel has the highest fundamental frequency.
7. Any instrument (whether or not it is made of wood) in which the length of the vibrating air column is varied by opening and closing holes at the side, is called a woodwind.
8. The frequency of vibration of an open column of air is twice that of the same length of column closed at one end.

DOUBLE TROUBLE

For acne blemishes

See the package on the right? That's the latest troublemaker for acne blemishes. New White Vanishing Formula Clearasil. It works on the spot(s) to fight today's blemishes, and drinks up excess oil that may cause future problems. It's the great new sidekick to Famous Flesh-Tone (package on the left) that hides blemishes while it works. Choose either one: they both mean serious trouble for acne blemishes, because Clearasil is serious blemish medicine.

Oh, yeah. See the next page for details on the...

Tape-it-along special from Clearasil

brainteasers

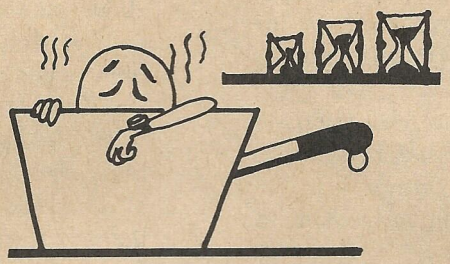
Last Horse Wins

The riders of two tired old horses were debating which of the two animals could run faster. Each rider was certain that the other man's horse was the faster of the two. How could they resolve the question?

Ed Reardon
Seneca, Ill.

Slow Boil

Suppose you want to boil an egg for exactly four minutes. The only timing devices available are three hourglasses.

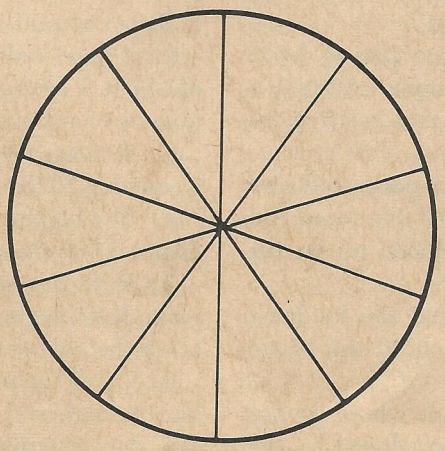


One measures an interval of three minutes. Another measures five minutes; and the third an interval of six minutes. How can you boil your egg correctly?

Gail Tunnell
Asheboro Jr. H.S.
Asheboro, N.C.

Opposite Numbers

Consider the circle below, divided into ten sections. Using the numbers 1-10, try to place a number in each section so that the sum of any two adjoining sections equals the sum of the two opposite sections.



Dennis Gallo
Cherry Park Grade School
Portland, Ore.

Do you have a favorite brain teaser? Send it to Senior Science, 50 West 44th St., New York, New York 10036. We will pay five dollars for each one published. Include the name of your school, home address, grade, and age. In case of duplicate submissions, choice will be made on the basis of presentation and clarity.

Dollar Drain

Three men registered for one large room in a hotel. They paid the manager $30 – $10 apiece. After the men had gone to their room, the manager realized that the correct rate was $25. He gave the bellhop $5 to be refunded to the three men. The bellhop decided that it would simplify bookkeeping if he kept $2 himself and returned $3 – $1 to each man.

The next day as the men were checking out they thanked the manager for refunding $1 to each of them. The manager summoned the bellhop, fired him, and demanded that he return $3. The bellhop insisted that he had taken only $2.

The manager reasoned that each man had originally paid $10 and received $1 back. Thus, each man paid $9, or a total of $27. At first, they had paid a total of $30. Thus, the bellhop must have the $3 difference.

The bellhop knew he had taken only $2. Where is the missing $1?

Kathie Curfman
Sunnyside Jr. H.S.
Sunnyside, Wash.

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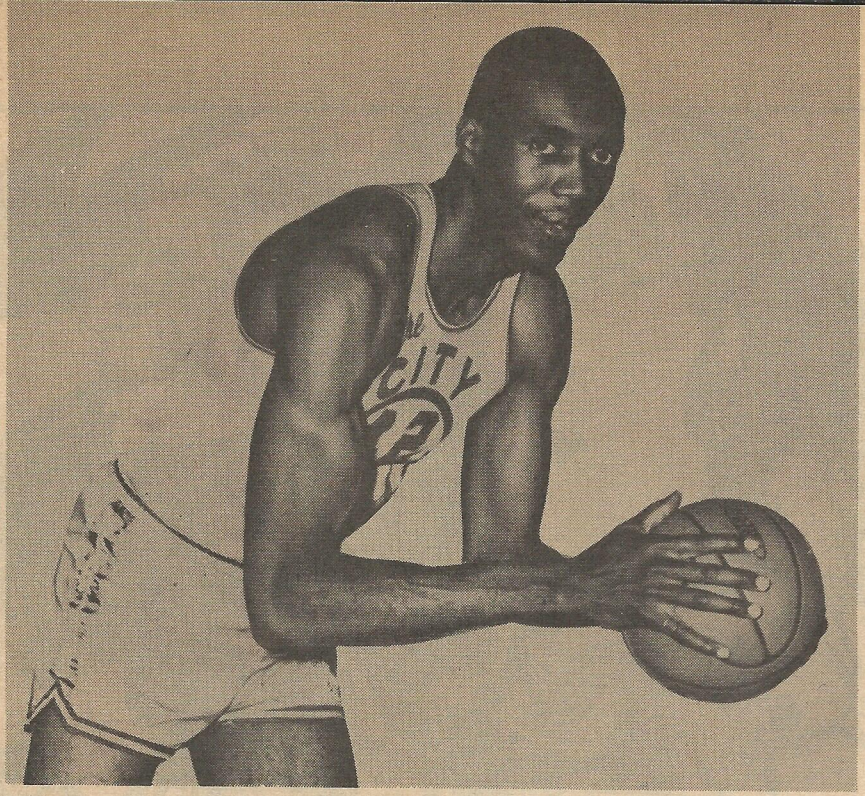

SPORTS

HEAD MAN AT LAST!

THREE OR FOUR years ago there was no question about the greatest centers in pro basketball. No. 1 and No. 2 were Wilt Chamberlain and Bill Russell – in *either* order. No. 3 was Walt Bellamy, and No. 4 was Wayne Embry.

By 1966-67, Chamberlain and Russell were still 1-2, but a 6-11 "hill" from San Francisco had suddenly begun to cast a long shadow over the center circle. Nate Thurmond had "arrived." You could no longer say that Chamberlain and Russell were in a class by themselves. The big, quiet Warrior with all those rippling muscles was right up there with them.

At 6-11 and 235 pounds, he certainly had the size. And he just as certainly had the talent to go with it. He hit the boards like a giant kangaroo, blocked shots better than anyone except Bill Russell, ran like a little man, played a selfless team game, and, though always looking to feed his teammates, still scored his 19 or 20 points a game.

Thurmond and his great teammate, Rick Barry, led the Warriors to first place in the Western Division, then gave the Philadelphia 76'ers a terrific battle for the championship.

Everyone who saw the series – in person or over TV – finally realized that Chamberlain and Russell no longer "owned" the center circle. That big guy, Thurmond, could play with them any night in the week.

After the series, Chamberlain said: "Thurmond is the toughest center in the NBA. He can rebound, play defense, and score. He's a tremendous center, and I don't think he gets the recognition he deserves."

Elgin Baylor said: "I haven't seen Thurmond play a bad game yet. I don't think most people have any idea how valuable he is."

And Jerry West went even further: "To me, Thurmond is the finest all-around center in the league. I can't understand why he is short-changed by the fans and the writers."

That's the story of Nate Thurmond's life. He has always had to play second fiddle to someone. At Bowling Green State University, Nate was recognized as a great ball-player. The team did a lot of winning, and Nate got his share of honors. But the headlines went to his teammate, Howie Komives, who led the country in scoring (and now plays for the N. Y. Knickerbockers).

The pro scouts weren't fooled, however. They knew that Nate had the perfect tools for the pro grame. But that didn't prevent two teams from making a bad mistake in the draft.

The Knicks, though desperately needing a big man, chose Art Heyman. The Bullets, since they already had a big man in Walt Bellamy, picked Rod Thorn. The next choice fell to the Warriors, and they quickly proved how smart they were. Though they had the best big man in the NBA in Wilt Chamberlain, they still grabbed Thurmond.

It was a master stroke – for the Warriors, but not for Nate. Imagine having to break in with a team that had Chamberlain at center! That meant two things for Nate: he'd have to play forward and he'd have to play in Chamberlain's shadow.

Nate was too much of an athlete to cry about it. He went out and learned how to play his new position. Though he made the all-rookie team (1964), he enjoyed only a modest year. He played about 26 minutes a game and averaged only 7 points. But, more important, he picked off about 10 rebounds a game in that limited time.

In 1965, everything changed. Chamberlain was traded to Philadelphia, and Thurmond was moved back to his natural position, center. The big fellow quickly became a favorite with the Warrior fans. He blocked shots a la Bill Russell, averaged 16.5 points a game, and finished No. 3 in rebounding.

It certainly looked as though Nate would become the shining star of the team. Then it happened again. Rick Barry, fresh out of Miami, arrived in San Francisco. A fantastic shooter and driver, Rick had to have the ball, and Nate made it his business to feed it to him. So it was Barry who became the shining star. Nate had to slip back into the shadows, and he stayed there as Rick tore the league apart the past two seasons.

Then Lady Luck stepped in and tapped Nate on the shoulder (though she had to get on a step-ladder to do it). Barry decided to cast his fortunes with the new pro league (the ABL), and that left Thurmond to carry the whole team.

Back in October, most of the experts felt that Nate, with all his talent, couldn't possibly make up for the loss of Barry. But Nate fooled them. Despite all the pressure on him, he bloomed into a super star. He hit the boards harder, scored more, blocked more shots, and locked up every center he played against.

Thurmond clearly moved ahead of the aging Russell in the center ratings, and now only Chamberlain stands a half-step in front of him. Can Nate close the gap? Not this season. Just when he was going like a house on fire, fate stepped in and dealt him a knee injury that put him out for the year – typical Thurmond luck.

But one thing is sure. Nate has thrown away his second fiddle for good. He's now blowing a lead trumpet. When healthy, he plays the sweetest center this side of Wilt Chamberlain.

– Herman L. Masin, *Sports Editor*

ANSWERS TO PUZZLE
(see page 24)

	S	T	A	R		N		H	O	G	S	
M		A	S	T	R	O	N	A	U	T		N
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SENIOR SCIENCE 3-7-68

For Further Reading

Silicone Chemistry

Hyde, J. F., "Chemical Background of Silicones," *Science*, Feb. 19, 1965.

Speier, J. L., "The Si-C Bond and Silicones," *Chemistry*, July 1964.

Friedlander, S. K., "Plastic Hearts, Membrane Lungs, and Artificial Kidneys — The Engineering of Vital Organs," *Engineering and Science*, May 1967.

Rochow, E. G., *Introduction to the Chemistry of Silicones*, Wiley & Sons, 1961.

Freeman, G. G., *Silicones: An Introduction to Their Chemistry and Applications*, Lliffe Books, London, 1962.

Scorekeeper

(see page 15)

I. Silicone Chemistry

1.F; 2.F; 3.T; 4.T; 5.T; *6.T; *7.T; *8.T.

II. Today's Scientists

1.F; 2.T; 3.T; 4.F; 5.F; 6.F; 7.F; *8.T; *9.T.

III. Critical Issues In Science

1.T; 2.F; 3.F; 4.F; 5.F; 6.T; 7.F; *8.T.

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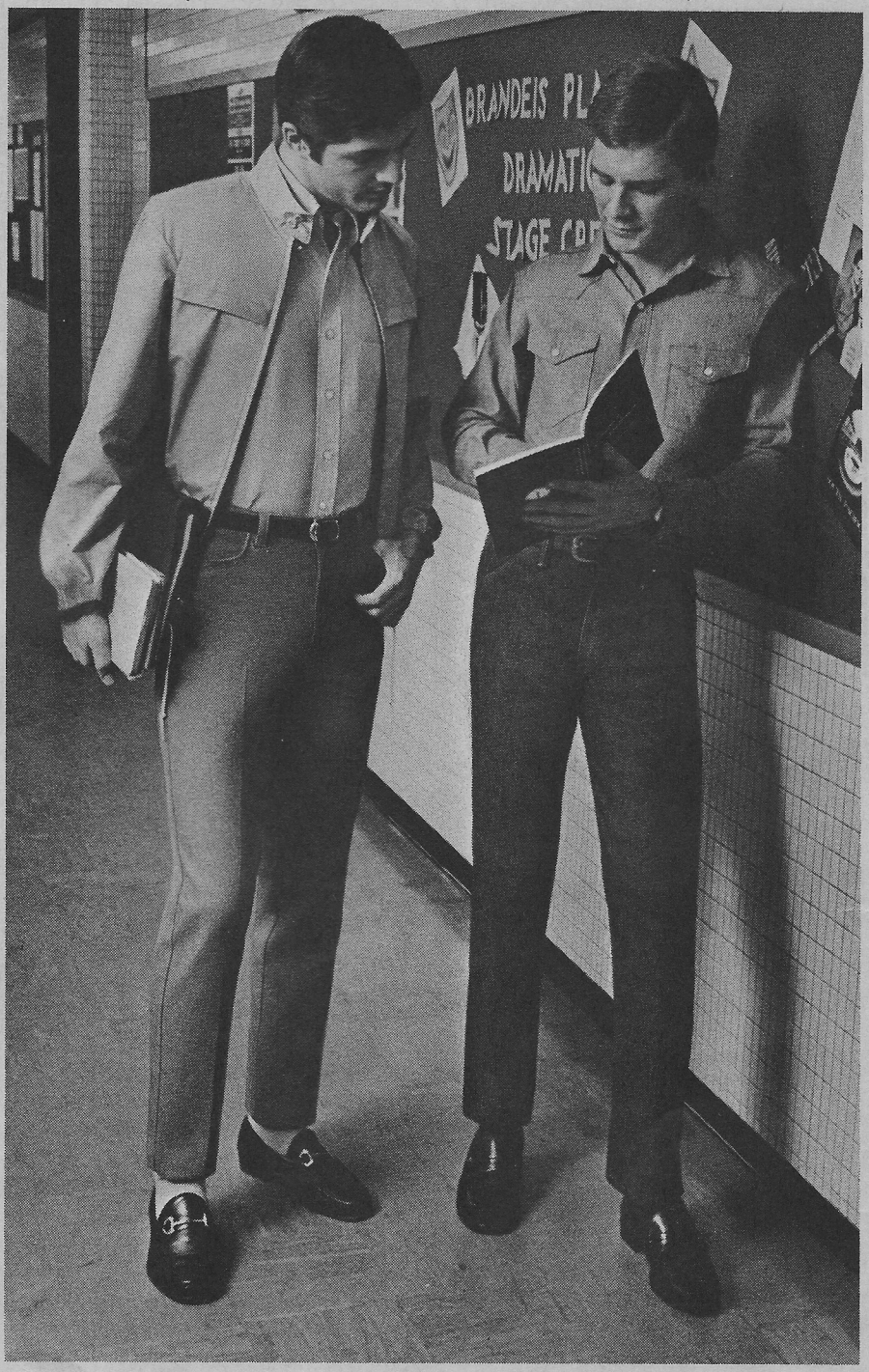

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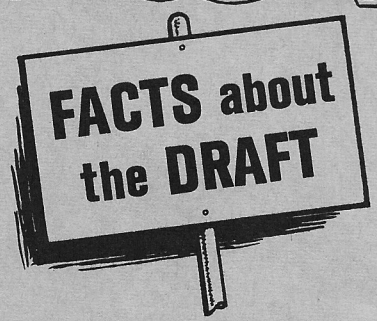

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Today's Scientists

continued from page 8

enough promise to impress Dr. Saunders. When she volunteered to make test instruments for him, he accepted. Together, they spent 1950 to 1958 testing the effects of varying wood thickness, size and shape of f-holes, depth of the sides, and other variables of violin construction.

Along the way, Mrs. Hutchins learned the true significance of *tap tones*. Violin-makers had long put great store in the sound of the unassembled top or back – called the plate – when rapped with a knuckle. For her ear, Mrs. Hutchins substituted a microphone and sound analyzers. Borrowing a technique Dr. Saunders used for complete violins, she connected the plate to a loudspeaker coil and vibrated it over the audible range of frequencies. From the loudness peaks of the plates, she learned to calculate what the violin body peak would be *before* it was assembled.

By this time, Mrs. Hutchins knew how to make a good violin consistently, by design, rather than occasionally, by feel and luck.

As a real challenge, she tore apart a $5 violin Dr. Saunders had used for years as his standard of *badness*. After she had reworked it, they had it played in competition with a Cremona violin before a college music department. Both violins were played behind a screen by the same musician. They were voted equal in tone!

One thing the fiddle fiddlers could *not* do was improve on the old violins. Eight years of testing and trying showed them that the Italian craftsmen had perfected the design.

Violas and cellos were a different story. The three important loudness peaks in these violin-type instruments were too high, and left the low notes weak. As for the bass viol, it was the last remaining member of an inferior string family long ago supplanted by the violin group. The four stringed instruments – violin, viola, cello, and bass – together could not even cover the range of the piano keyboard, composers complained.

Dr. Saunders and Mrs. Hutchins therefore decided to create a whole new family of eight fiddles, patterned on the violin and up to its standard. The smallest would be two sizes smaller than the violin, the largest, one size larger than the bass.

To save time, Mrs. Hutchins worked mostly by altering existing odd-sized instruments. By 1962, six of them were ready. The largest and smallest, however, had to be built from scratch.

For the smallest fiddle, tuned one octave above the normal violin, the highest string had to be pulled so tight that conventional steel strings always broke. Finally, a wire developed for wrapping around rocket cases was found to withstand the strain.

When the family of fiddles was complete, interested musicians got together and played new music composed for them. But now the violinists began to complain. For years, they had been losing out to the increasing power of the other orchestral instruments. And in solo they could not reach the backs of new, larger halls. Now they were being drowned out by the power of the new strings. The "perfect" violin needed improvement. Mrs. Hutchins obliged with the "he-man" violin.

To make it louder, she made the plates longer. But, everything else being equal, larger plates would resonate at a lower frequency. To raise the body resonance back in step with violin tuning, she had to make the plates stiffer. This she did by making the wood thicker and arching it more.

The new family of fiddles is slowly winning over musicians. After hearing them in concert, conductor Leopold Stokowski said, "The strings have needed this treatment for a long time."

Violin-makers are coming around more reluctantly. Many continue to guard their techniques, and Mrs. Hutchins is still not above learning from them. Says she, "When I'm talking to one of them and get close to one of his secrets, he gets all shaky. Then I know I've got something, and go home and try it out."

— Bruce Frisch

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BY ROY HEMMING

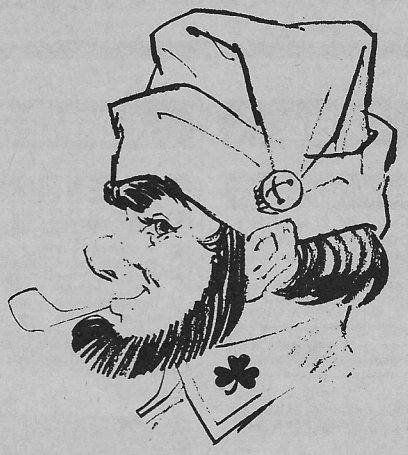
with Robin McBride, Ed Coach, Buzz Royden

CLASSICAL ALBUM OF THE WEEK **Leonard Bernstein Conducts Music of Our Time, Vol. 2—Bernstein, New York Philharmonic** [*Columbia MS7052*]. If you think the wildest, mind-blowingest sounds of our age are coming out of Fillmore and other rock emporiums—or even out of a few *avant garde* jazz dens—well, you haven't heard the dozen or more "Music of Our Time" LPs that Columbia has been releasing over the past few months. This is one of two conducted by the ever-adventurous Leonard Bernstein, and is one of the best of the lot. It features music by two Americans (Gunther Schuller, Lukas Foss) and—surprise!—one aleatoric Soviet composer (Edison Denisov). Foss' *Phorion* is the most immediately intriguing. Its title is from the Greek word meaning "stolen goods." The goods in this instance is a Bach partita. Foss assigns the notes of the Bach work to different groups of instruments who proceed to play them at irregular intervals—as decided by the conductor as the performance goes along. The effect, to quote Foss' notes, is like "torrents of Baroque notes [being] washed ashore by ocean waves, sucked in again, and returning *ad infinitum*." The piece does not go on quite forever—though perhaps a bit longer (10 minutes) than it should. Denisov's *Crescendo e Diminuendo* makes its points more succinctly (6 minutes), and indicates that some of the ideas of Boulez and Nono have indeed penetrated the Iron Curtain. Schuller's 17-minute *Triplum* is the most complex and challenging of the LP's three works, with a remarkably expressive final section which proves that (contrary to some critics) this type of structured modernism may have "heart" after all. The performance Bernstein gets out of the New York Philharmonic is remarkable—proving once again that the orchestras of Boston and Philadelphia may have more silken sheens but that the Philharmonic is the most versatile and technically adept of any orchestra in the world. (R.H.)

Prokofieff: Symphony No. 4—Rozhdestvensky, Moscow Radio Symphony [*Melodiya/Angel SR40040*]. The 4th, based in part on material from Prokofieff's 1928 ballet *The Prodigal Son*, was originally commissioned by the Boston Symphony in 1930. It remained a favorite of the composer's even if not of the critics or the public—so Prokofieff revised it extensively a few years before his death in 1953. Even with a fine Ormandy-Philadelphia recording [*Columbia MS6154*], the revised symphony has *still* not "caught on" as much as some of Prokofieff's other works. It deserves to, however, for it is a fascinating work. It may lack the humor and sting many associate with Prokofieff—

Continued on next page

Draw the Leprechaun



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FOLLOWING THE FILMS

HALF A SIXPENCE
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If H. G. Wells were alive today, the transformation of his novel *Kipps* into a rollicking musical comedy would probably astound him. Although he wrote the book in an ironically humorous style, his motive was social reform. He wanted to show English Edwardian society the pettiness and absurdity of its rigid social class structure. Wells was almost as merciless toward his hero, Arthur Kipps, whom he depicted as a pathetic social climber, unable to see through the false values of the well-to-do.

Although its theme was more grim than jolly, *Kipps* proved to have what it takes to make a hit musical. Re-christened *Half a Sixpence* and laced with songs and dances, it ran successfully on the London stage for two years, and later became a Broadway hit. Movie producer Charles Schneer recognized its visual possibilities, and he and director George Sidney (who also directed the movie versions of *Kiss Me Kate* and *Bye Bye Birdie*) have turned it into a lively and lovely large-scale film.

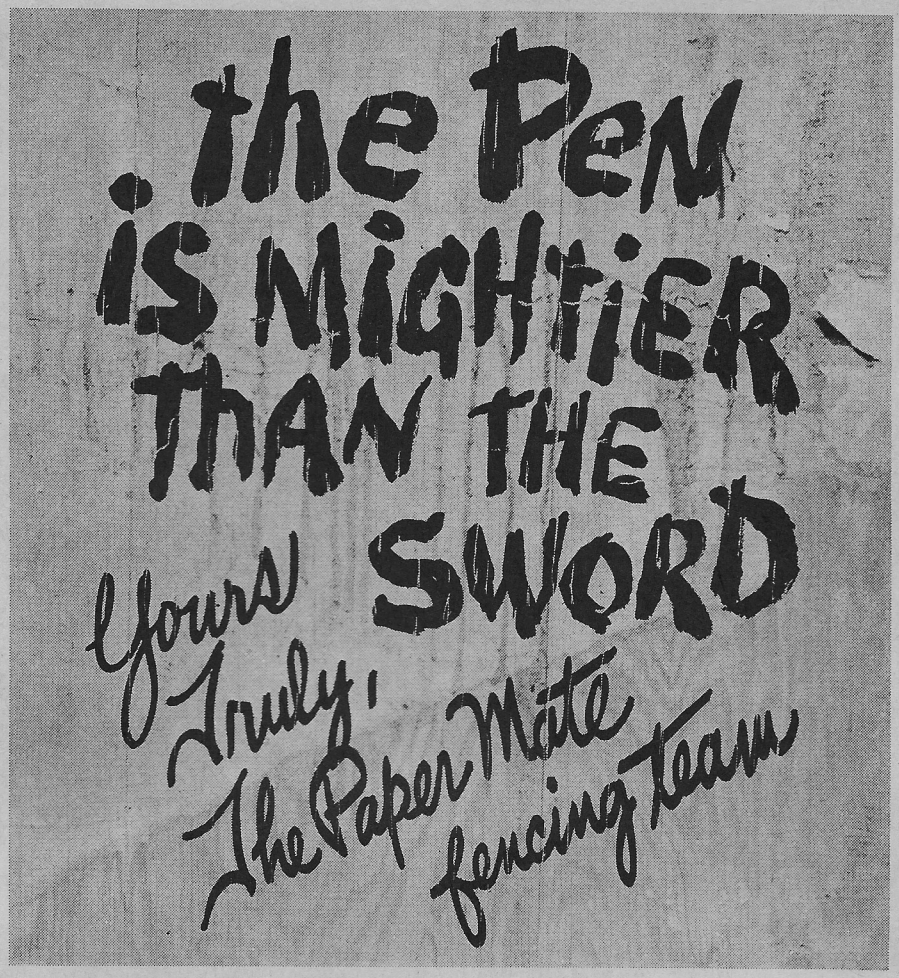
Much of *Half a Sixpence's* zest and zing is due to Tommy Steele, who plays Arthur Kipps with the practiced ease that four years in the role onstage gave him. If you have never seen Tommy before, your first impression may be like mine – wide screen, relentlessly grinning teeth. But don't make for the nearest exit. When that impact fades, he settles down into being simply a smasher, and unless you're a determined sourpuss, the sheer force of his energy and self-assurance is bound to perk up your spirits. He may not be the Arthur Kipps that Wells envisioned, but watching him bounce around the screen like a demented pogo stick is good for anyone's tired blood.

Tommy is obviously ready, willing, and able to carry the show by himself, but he doesn't have to. He gets plenty of help from the director, the cameramen, and fellow performers like Julia Foster as the poor girl he marries, Penelope Horner as the rich girl he loves, Cyril Ritchard as a mad playwright, James Villiers as a rascally snob, and Christopher Sanford as Kipps's fellow apprentice. The color photography is a delight, suiting mood and shade to each scene. A regatta on the Thames is washed with dreamy greenish light; interiors of Blenheim Palace glitter barbarically; the "Must Have a Banjo" number blares with harsh, primary colors.

The faults of *Half a Sixpence* are those of excess. It is too long, and too many of its songs are forgettable, and its dance numbers repetitive. But it is bright, beguiling, and buoyant, and it lights up the screen like a fireworks' display. Although it is a film for the whole family, it is never a bland, saccharine, so-called "family film." It is unabashed entertainment, and if that is what you are looking for, *Half a Sixpence* will give you your money's worth.

— MARGARET RONAN

Half a Sixpence has received the *Scholastic Magazines* Bell Ringer Award. These awards are given to motion pictures that meet *Scholastic Magazines'* standards of excellence in direction, acting, photography, and appropriateness of subject matter.



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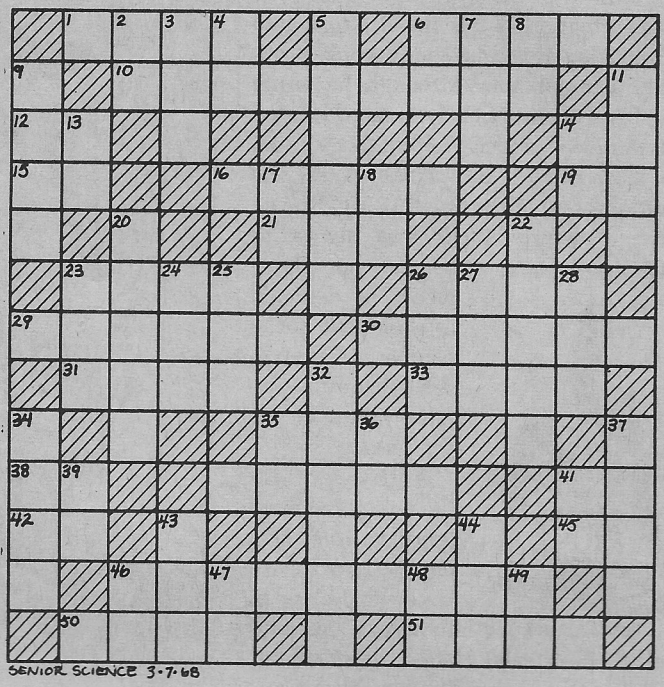
Starry

By Robert M. Hale, Soddy-Daisy H. S., Soddy, Tenn.

★ **Starred words refer to astronomy or astronautics**

Students are invited to submit original crossword puzzles for publication in *Senior Science*. Each puzzle should be built around one topic in science, such as astronomy, astronautics, botany, geology, electronics, famous scientists, etc. Maximum of 50 words, of which at least 15 must be related to the theme. For each puzzle published we will pay $10. No entry will be considered unless it includes all of the following: symmetrical puzzle design and design with answers filled in, definitions, answers on separate sheets, and a statement by the student that the puzzle is original and his own work. **Puzzles must be symmetrical.** Keep a copy, as puzzles cannot be returned. Give name, home address, school, and grade. Address: Puzzle Editor, *Senior Science*, 50 West 44th Street, New York, N. Y. 10036. Answers to this puzzle are on page 19



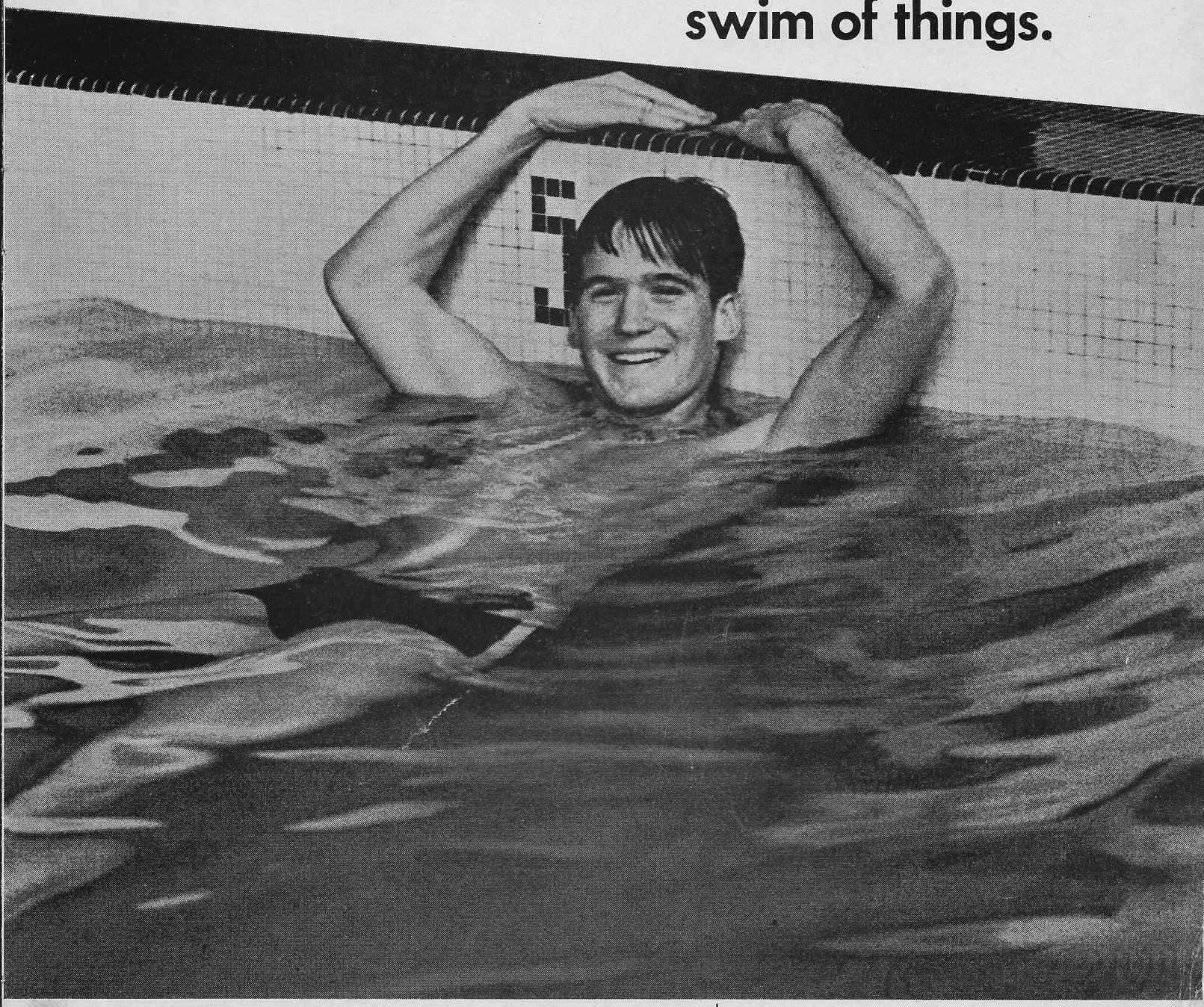
ACROSS

* 1. Luminous heavenly body.
6. Swine.
*10. American spaceman.
12. Preposition.
14. In order that.
15. Railroad *(abbr.)*.
16. Higher than.
19. Appliance that requires a picture tube.
21. Fuss.
23. Israeli's opponent.
26. A season.
*29. Highest point in orbit.
*30. Large gaseous mass in space.
31. Paradise.
33. Wagers.
35. American Medical Association *(abbr.)*.
38. Exclamation.
*40. Area beyond the atmosphere.
41. Accomplish.
42. — and Pa.
45. Two *(homonym)*.
*46. Russian spaceman.
50. Ammunition *(slang)*.
*51. Hindrance to progress of space capsule.

DOWN

2. Total amount *(abbr.)*.
3. Small poisonous snake.
4. Right *(abbr.)*.
5. No person.
6. Another exclamation.
7. In *(antonym)*.
8. Gross ton *(abbr.)*.
* 9. Planet with "canals."
*11. Exploding star.
13. Translator *(abbr.)*.
14. Straight *(abbr.)*.
17. Received at college graduation.
18. Verbal orders *(abbr.)*.
20. To wear away.
*22. Ninth planet.
23. Large hairy mammal.
24. To grow old.
25. ——— Franklin.
26. Second month *(abbr.)*.
27. The Rail Splitter.
28. Lines *(abbr.)*.
32. Longest river in South America.
34. Title by which any person or thing is known.
35. Major news source *(abbr.)*.
36. Type of current.
*37. The satellite of the Earth.
39. Same as No. 6 Down.
41. Delirium tremens *(abbr.)*.
43. Pop's mate.
44. Belonging to us.
46. A metric unit *(abbr.)*.
48. B.C. *(antonym)*
49. Thanks (British slang).

Steve Clark is in the swim of things.



Student, coach, author and sometimes lecturer . . . that's Steve Clark. He has also set three world swimming records. Has won three Olympic gold medals.

He's at Harvard Law School now. Getting set for a career in international law. And when he's not in class or studying, he helps coach swimming at MIT and the Cambridge YMCA, writes and occasionally lectures at local high schools. He does it all and still takes time out for ROTC. Ask him why and he'll tell you—"that's the best way to do it." Like everything else he does.

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